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THE SURGICAL CLINICS OF NORTH AMERICA

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FILTRATION PHENOMENA IN RELATION TO CLINICAL MEDICINE

WILLIAM J. MAYO

—

The great advances in modern medicine are coming from a better understanding of those vital processes which are beyond the microscope.

Sir William Bayliss has well said that the dividing line between physics and chemistry has disappeared, that only under certain physical conditions can there take place the electric exchange of electrons and protons in the atomic field which we speak of as chemistry.

The colloidal particles vary in size between the extremes of $1/10$ micron or $1/250,000$ inch, and $1/1,000$ micron or $1/25,000,000$ inch in diameter. With the ultramicroscope colloid bodies can be detected up to $1/100$ micron or $1/2,500,000$ inch in diameter, but beyond this point detection depends on the diffraction of light by colloids suspended in fluids or gases, or on mass colorimetry. The electromagnetic vibration which we speak of as the x -ray is only $1/100,000,000$ inch in length. It is smaller than the atom, so that it is diffracted by the atom. Experimental use of the x -ray has permitted analysis of the atom and its separation into the protons, or positive units, and the negative electrons, which are the active sources of energy.

Protoplasm might be said to be composed chiefly of material in colloidal form; that is, small particles which are of such size as to be readily susceptible of molecular change. They are, in

fact, sources of vital energy Pictorially speaking, colloids are little engines, in which the actual combustion takes place through atomic changes in the molecules which form these particulate masses

The organs of the body are composed, among other things, of a series of filters which are adapted to the size of physical materials, permitting certain of them to pass through, but retaining others This process of separation is referred to here as filtration without any attempt to define the exact physical or the physiologic mechanism involved Krogh, following earlier investigators, showed that the walls of the vascular capillaries contain *contractile cells derived from the nonstriated muscle*, which are to a large extent self-controlled He proved that under the circulatory pressure of the systole of the heart the arterial capillaries dilate At one time he suggested that the gases, liquids, and crystalloids which move between the blood and the tissues pass through stomas whose size is to a certain extent controlled by the muscular mechanism of the capillary He believes that the passage or retention of any substance depended on the size of its molecule or particle, in relation to the size of the stoma and in relation to the vascular pressure Except in special organs, the stoma was never normally large enough to allow colloid particles to pass When certain toxic poisons, for example, histamin, paralyze the contractile cells, causing the capillary to distend, the change in capillary pressure and the increased permeability of the wall permit larger bodies, such as the colloids of the blood plasma, to pass from the capillaries into the tissues, producing the condition known as shock.

The function of the kidney may be defined as the filtration of noncolloid constituents of the blood plasma through the capsule, and the resorption of threshold bodies in solution through the tubule cells The kidney is a filter, whose function is to eliminate from the blood certain molecular metabolites, such as urea, chlorids, and creatinin Urea is one of the smallest of the molecules and is not hydrated; that is, does not change in size by absorbing water The filtration rate of urea is about the same as that of the dye, phenolsulphonephthalein, which Rowntree

and Geraghty showed was eliminated through the kidney just about as was urea.

Rowntree has also shown that the dye, phenoltetrachlorophthalein, when injected into the blood stream, passes out through the bile; a test of the filtering capacity of the liver.

Further experiments with the spleen, which is one of the reticulo-endothelial organs, show that it is in some respects a coarse filter, which under certain conditions filters out, by phagocytic action, substances of sufficient size to be seen with the microscope, such as India ink, bacteria, and degenerated cellular elements of the blood. These substances are promptly attacked and, in some instances, broken down by the specific splenic cells, the lymphocytes, splenocytes, and monocytes, and the material sent on through the portal vein to the liver for detoxication and salvage.

The four organs of the body considered vital are the heart, the lungs, the kidneys, and the brain. If one studies the causes of death as tabulated in surgical clinics, one finds the largest number charged to the lungs, and the next largest to the kidneys, while only a small number are attributed to the nervous system, and the smallest number to the heart. Yet, if one goes below the surface appearance, and studies the organ which has been charged with the death, one very often finds that it was not primarily responsible, but was merely the executioner. For instance, certain deleterious insoluble substances, such as bacteria, picked up by the lymphatics and passed through the thoracic duct to the blood stream and eventually to the lungs, result in those pathologic changes due to minute emboli and infarcts which we speak of as pulmonary complications.

One of the most interesting of the toxemias is that concerned with the failure of the kidneys to eliminate urea, which is the nitrogenous waste of protein embolism, and creatinin, a waste product which is a fair index of the endogenous metabolism of the body tissues. The kidneys also excrete the excess of water beyond that necessary to maintain the physical state of fluidity of the tissues and blood plasma essential to ionic exchange. Arrhenius, the Swedish investigator, showed that molecular

and atomic particles form solutions which may undergo electrolytic dissociation into the positive and negative parts which constitute the ions. Chlorid of sodium, in watery solution, illustrates this faculty of dissociation, or ionization, in contrast to glucose or urea, for instance. Salt in aqueous solution is always dissociated. This is true for the urine, blood, and tissue fluids. The biologic importance of this dissociation has recently been demonstrated by Keith and Whelan, who administered sodium chlorid solutions intravenously to dogs and to human beings. The experiment showed that the chlorin and the sodium may be excreted independently and at entirely different rates. For instance, in ten persons injected intravenously with .0714 gm of sodium chlorid for each kilogram of body weight, the excretion of chlorin in two consecutive hours varied from 4 to 20 per cent, and the excretion of sodium from 0.9 to 9.6 per cent. Woods Hutchinson has suggested that the natural craving for salt is partly due to the iodine associated with it, and points out that since the early progenitors of man were marine animals, both iodine and salt are necessary to life. It has been found that goiter is endemic in geographic locations far removed from the sea, the mountains of Switzerland, for instance, where the readily soluble iodine and chlorid content of the soil has been drained.

At the present time the various toxic states related to kidney filtration can be studied with relative ease because greater knowledge of the kidney is available than of any other organ of the body. One can pictorially classify the nephritides on evidence gained by examination of the blood, as (1) the chloremic type, which is associated to a large extent with chlorid retention and consequent edema from changes in the tissue colloids, and (2) the uremic type, sometimes spoken of as Bright's disease, associated with retention of urea.

The clinical phenomena connected with these blood toxemias are most interesting. The blood content of urea is normally 26 mg. for each 100 c c. When it rises above 125, a very serious condition is indicated, but recovery may take place even when it rises to 300 or more, provided the cause is some barrier to elimination which may be removed, such as prostatic hyper-

trophy. Creatinin, which might be described as the ashes of the worn-out tissues of the body, with a normal blood content of 2 mg for each 100 c.c. may go above 10, when a serious condition is again represented.

The toxemia frequently associated with high intestinal, gastric, or duodenal obstruction is of peculiar interest in that, as the urea and creatinin increase, the chlorid deficiency develops in the blood which is not well understood, but is perhaps the most serious difficulty. Normally the chlorid content varies from 560 to 650 mg for each 100 c.c. As it decreases, which it does at times to one-half normal, a condition of alkalosis usually develops which is shown by a rise of the carbon dioxid combining power of the plasma. This is normally from 56 to 65 volumes per cent. When it exceeds 100 volumes per cent, tetany may develop. This is to be distinguished from tetany due to low calcium. In twelve cases of tetany in which careful studies of the blood were made, the carbon dioxid combining power was under 95 (88) in only one case, while in one or two cases it rose to 150.

The introduction of physiologic sodium chlorid solution by rectum, subcutaneously, or intravenously, with sufficient glucose to maintain a ready source of heat and energy, has a remarkable effect in stimulating renal function, and in combating the toxemia of intestinal obstruction. My colleagues, McVicar and Balfour, in cases of this description, give to an adult intravenously, 1 liter of 1 per cent sodium chlorid solution, with 10 per cent of glucose, two or three times in twenty-four hours, and have had some extraordinary results in resuscitating patients apparently moribund.

The chemical findings in the blood in a form of toxemia encountered at times in biliary obstruction are quite different from those attending high intestinal obstruction. The toxemia of the biliary obstruction is more often associated with acidosis, while that of high intestinal obstruction is usually associated with alkalosis. The treatment, of course, is different in the respect that sodium carbonate instead of chlorids is given with glucose in cases of biliary toxemia complicated by acidosis.

and atomic particles form solutions which may undergo electrolytic dissociation into the positive and negative parts which constitute the ions. Chlorid of sodium, in watery solution, illustrates this faculty of dissociation, or ionization, in contrast to glucose or urea, for instance. Salt in aqueous solution is always dissociated. This is true for the urine, blood, and tissue fluids. The biologic importance of this dissociation has recently been demonstrated by Keith and Whelan, who administered sodium chlorid solutions intravenously to dogs and to human beings. The experiment showed that the chlorin and the sodium may be excreted independently and at entirely different rates. For instance, in ten persons injected intravenously with 0.714 gm of sodium chlorid for each kilogram of body weight, the excretion of chlorin in two consecutive hours varied from 4 to 20 per cent, and the excretion of sodium from 0.9 to 9.6 per cent. Woods Hutchinson has suggested that the natural craving for salt is partly due to the iodine associated with it, and points out that since the early progenitors of man were marine animals, both iodine and salt are necessary to life. It has been found that goiter is endemic in geographic locations far removed from the sea, the mountains of Switzerland, for instance, where the readily soluble iodine and chlorid content of the soil has been drained.

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ULCER OF THE STOMACH AND DUODENUM

CHARLES H. MAYO

Within the last few years radical excision has been more persistently advocated and more frequently applied in the treatment of ulcers of the stomach and duodenum. The pylorus, part of the stomach, and even part of the duodenum are to be excised regardless of the severity of the lesion. Thus the old Billroth No. 1 operation, of the vintage of 1881, is being resurrected and put to wide use. Originally it was intended for the relief of obstruction, whether from gross ulcers of the stomach, contracting ulcers, or superimposed carcinomas. Now that the pendulum has swung through so many stages in the surgical treatment of diseases of the stomach and clear back to its starting point, it is time to take an inventory of the stock of operative methods. The procedures may be many, but it cannot be expected that one line is going to fill the varying demands. Indeed I believe that surgical wares are not always required as urgently as they are offered. The small duodenal ulcer, for instance, needs careful consideration, and even medical treatment; the resection of the lower third of the stomach, with the pylorus and first portion of the duodenum, is a misapplication of an operation the advantages of which, in other conditions, have been shown again and again.

The Billroth No. 1 operation was used by many surgeons, including Kocher. Heineke and Mikulicz introduced a method of pyloroplasty, which slowly gained favor. Billroth was compelled, by the high death rate of his original method, to present a second, in which resection with closure of the severed ends was followed by posterior gastro-enterostomy through the mesocolon. Kocher's method, a closure of the stomach with posterior gastro-duodenostomy, was not well received. Loretta contributed a

If the renal function, in relation to the elimination of urea, chlorids, and creatinin, is so reduced that the urine cannot concentrate normally, a large intake of water is necessary. That is, if the kidneys are able to concentrate the urine to a specific gravity of only 1 005 to 1 010, the patient must take extra water to insure proper elimination through the kidneys. A patient with the cardiorenal syndrome, however, because of the heart complication may not be able to take a large amount of water. Careful watch should be kept to see that elimination corresponds with intake.

It is in this field that a great opportunity exists for cooperation between the internist and the surgeon for restoration of function, both before and after operation. Researches along this line are bringing into the field of safe surgery many patients suffering from secondary toxic conditions whose functions are capable of rehabilitation by measures based on exact physicochemical studies.

ant attitude, we have been allowed to see at necropsies, during the last three years, many healed ulcers of both the duodenum and the stomach, although careful examination had never revealed any history or other indication of them. The sensitiveness of the stomach to ulcer varies in different persons, just as it does to the reflex effect of disease elsewhere. Symptomless ulcer is an illustration of one extreme; pylorospasm, due to disease in the gallbladder or appendix, illustrates the other.

About 78 per cent of the ulcers occur in the duodenum, in spite of the alkalinity of the duodenal secretions. Brunner's glands are massed between the pylorus and the ampulla, to neutralize the acid and inactivate the pepsin from the stomach. I have never seen an ulcer below this portion of the duodenum.

The relaxation of the pylorus produced by alkali is well illustrated after an anastomosis has been performed between the bile channels and the stomach. What the intestinal secretion does periodically, the bile now does constantly, and the pylorus, instead of opening intermittently as the acid in the first portion of the duodenum is neutralized, remains patent as long as bile is entering the stomach.

It was believed that ulcer was the result of the digestion of an area which had been deprived of adequate circulation. The blood-vessels do not form a network in the mucous membrane, but each small area has its own supply of terminal capillaries. If this terminal circulation is interfered with at a deep point, sudden perforation will follow on the death and digestion of that portion of the stomach wall.

These constitute the only early gastric ulcers seen by the surgeon, since the less acute types are always given medical treatment first. If that is going on satisfactorily, it should be continued, but if not, the physician and surgeon must agree on some other course of treatment. The patient must not be asked to bear a succession of relapses entailing serious interference with his daily work, as well as much worry over his condition and prospects. Surgery is now justified in offering to come to his aid.

Some form of pyloroplasty is used by many, and finds favor

because of the defects of gastro-enterostomy and the trouble that often follows it. Finney, whose operation has been widely used, advocates the Haberer method of pyloric division, duodenal closure, and gastroduodenostomy

Formerly I used permanent sutures, until I found, in two patients who required second operation after four years, that suture silk was hanging from the ulcer field into the stomach. Since there is no area in the abdomen more prone to speedy healing, I now use absorbable suture material, No. 2 chromic catgut outside and No. 1 inside.

Gastric surgery is designed to meet many difficulties and there are many types of operation still in use, because no one of them suits every surgeon. If each surgeon would study the various methods and find out which are best suited to his own abilities and limitations, the general mortality would sensibly fall. There is only one operation for a given surgeon, with a given patient, in the face of a given pathologic condition. The rights of the patient and the needs of the community demand that surgical procedure

CERTAIN DIFFICULTIES PRESENTED BY DISEASE OF THE BILIARY TRACT

E. STARR JUDD

Case I. Stones occurring in the common duct some years after cholecystectomy.—A woman, aged forty, was first seen at the Clinic October 7, 1916, at which time she stated that three years before, while pregnant, she had had four or five attacks of severe colic in the right hypochondrium, with radiation to the back and right shoulder. These attacks recurred at intervals of a few weeks and then disappeared. Similar attacks again appeared following parturition in February, 1916, and one of them was followed by a slight degree of jaundice. She said she passed several gallstones in the stools.

The patient was obese, weighing 211 pounds. The systolic blood pressure was 156, the diastolic 98. Examination of the urine was negative. The phenolsulphonephthalein test showed a return of 60 per cent in two hours. Operation was advised, the patient wished to defer it and returned home. She again came for examination October 21, 1924. In 1918, cholecystectomy had been performed elsewhere, at which time the gallbladder contained twenty-one gallstones. The patient was free from symptoms until 1920, when during her seventh month of pregnancy, she had another attack of colic and passed several gallstones in the stools. There was no jaundice at this time. She had no further trouble until 1922, when a severe attack occurred, associated with slight jaundice. From then on there was no trouble until August, 1924, since then she has had fourteen attacks of colic.

The patient was still obese, weighing 245 pounds. There was slight tenderness across the upper abdomen, but no evidence of jaundice. The systolic blood pressure was 150, the diastolic 100. Examinations of the urine and blood were negative. The serum bilirubin was 1.5 mg. for each 100 c c. The blood urea was 23 mg. for each 100 c c. The patient was sent to the hospital for observation and measures taken to reduce her weight. She was allowed to go home with instructions to follow a reducing diet and to return later for operation. While at home she had an attack of colic and passed a stone in the stool. She had six subsequent attacks of colic and returned again to the Clinic, January 6, 1925. She was not jaundiced at this time.

Operation, January 7, 1925, revealed evidence of cholangitis and a dilated common duct. The duct when opened contained normal appearing bile which was not under tension. Further exploration revealed four faceted stones in the duct, each about 0.5 cm. in diameter. These and the appendix were removed. A rubber catheter was fastened in the common duct for drainage. Recovery was uneventful.

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Usually those in the common duct and ampulla can be located and removed without great difficulty, but it is impossible to make certain that there are no small stones in the intrahepatic ducts. Fortunately, however, it is only in an occasional case that stones are present in the intrahepatic ducts. In this case, after the stones had been removed, a rubber catheter drainage-tube was passed upward in the common duct to the hepatic ducts. The tube had a lateral opening as well as the one at the tip. It was stitched in place in the duct with fine catgut and the incision in the duct was then closed around the tube. In certain cases when it has been difficult to pass the tube upward in the duct, it has been allowed to pass downward toward the ampulla, without any interference with effective drainage. The tube in the duct is usually all the drainage necessary. It is left in place for at least ten days and even longer than that if the bile is not draining around it. It is not a good plan to remove a common duct tube sooner than the tenth day, and often it is best to wait until it comes out of its own accord. Formerly a tube or piece of rubber tissue was used for drainage in addition to the tube in the duct, but since then this has found to be not only unnecessary but inadvisable. The wound in this fleshy woman was healed in two weeks, and she was dismissed in four weeks in good condition.

Case II. Deep jaundice with small common duct relieved by cholecystogastrostomy.—A woman, aged forty-one, first came to the Clinic March 20, 1914. During the previous four years, she had had repeated attacks of indefinite abdominal pain, which were usually relieved by food and medicine. The pain was never severe and she had never had jaundice.

Gastric analysis revealed free hydrochloric acid 58, and combined acidity 16. Fluoroscopic examination of the stomach did not reveal a lesion, and the patient was allowed to return home. She came to the Clinic again December 16, 1924, because of jaundice. Following her previous visit she had been well for four or five years. Three or four years ago she began to have periods of nausea and occasional vomiting with a burning feeling in the stomach. During the last year, these attacks had occurred about twice a month. The pain was at no time very severe. Two weeks before this visit she had a large (vomited

vomited everything she ate. There was no fever and no pain. Five days later, jaundice appeared and she noted that her stools were clay colored. The jaundice persisted.

The patient weighed 127 pounds. The systolic blood pressure was 140, the diastolic 90. There was a marked degree of jaundice. The urine contained a trace of albumin and considerable bile. The hemoglobin was 65 per cent, leukocytes numbered 3,900, the coagulation time (Boggs) was seven and one-half minutes, the bleeding time two minutes, and calcium time five minutes. The blood Wassermann reaction was negative. Total gastric acidity was 30, and free hydrochloric acid 18. roentgenograms of the stomach were negative. The patient was sent to the hospital for observation and further study. The blood urea was 18 mg. for each 100 c. c. The stools were examined repeatedly for bile but were always negative. The serum bilirubin December 22 was 11.2 mg. for each 100 c. c. This test was repeated on the four following days and showed a gradual drop to 8.5 mg. for each 100 c. c. and then a rise to 10 mg. for each 100 c. c. The coagulation time December 31 was eleven minutes and thirty seconds. Attempts to obtain bile by duodenal drainage were not successful. Three injections of 5 c. c. each of 10 per cent calcium chloride were given intravenously. There was not much change in the patient's condition nor in the degree of jaundice. It was felt that her condition was as good as possible under the circumstances, and operation was decided on.

Operation was undertaken January 2, 1925. Splanchnic anesthesia by the posterior route was combined with abdominal field block, using 0.5 per cent novocain. The gallbladder was large and contained several hundred medium-sized stones and thick concentrated bile. The head and body of the pancreas were large and indurated, and it could not be definitely determined whether the condition was pancreatitis or carcinoma. The common duct did not seem to be dilated and no stones could be felt in it. The gallbladder was emptied of its contents and anastomosed to the stomach. A Penrose drain was inserted. By use of the duodenal tube it was evident that there was free drainage of bile into the stomach. The jaundice had practically entirely disappeared when the patient left the hospital on the eighteenth day.

This case is of interest from several points of view. First, the patient had been examined ten years previously because of attacks of abdominal pain which seemed to be too indefinite to establish a diagnosis. From the ultimate findings, it is reasonably certain now that she was suffering from cholecystitis and that stones were probably present in the gallbladder at that time. We are realizing more than ever the importance in diseases of the gallbladder of operating as early as possible, because statistical studies show that much better results are obtained than when operation is postponed until the liver and pancreas have become extensively involved in the infectious process. Operation should not, of course, be performed until there is sufficient evidence to establish the diagnosis.

In a recent study of cases of Grade 1 cholecystitis in which operation had been performed, Hallberg has shown not only that the ultimate results in the early cases are better but also that, in the cases in which it was difficult to recognize the trouble at the time of operation because of the absence of stones and the ordinary signs of cholecystitis, a complete cure of all of their symptoms was obtained, provided the clinical history was one of clear-cut cholecystitis. The certainty that if the patient has had typical gallbladder colic he will be cured by cholecystectomy justifies basing the operative procedure on the clinical history. At the time this patient came for her second examination all of the typical signs of the trouble were present, even that of deep jaundice. This was ten years after the first examination, and it was fairly evident that she had cholecystitis with stones as well as biliary cirrhosis, and probably an associated affection of the pancreas.

At operation the characteristic large, hard liver and pancreas were found. There were many stones in a large gallbladder, but apparently none in the common duct. The duct was not dilated. It was the opinion that the associated trouble in the liver and pancreas was the result of long-standing cholecystitis and that there might also be malignant disease in the pancreas. There was a good quantity of bile in the gallbladder and, after the stones had been removed, an anastomosis was made between the fundus of the gallbladder and the anterior wall of the stomach. Very soon afterward the jaundice began to diminish, and in two weeks had entirely disappeared. If the condition is inflammatory, there will be no further trouble, and if malignant disease is present in the pancreas, there may still be freedom from trouble for several years. It is better to anastomose the gallbladder to the stomach rather than to the duodenum. At first it is surprising to think of bile constantly pouring into the stomach and passing on without any functional disturbance. Recently it has seemed to us that possibly there might be some after-effect of the bile in the stomach, because these patients, even with deep jaundice present, do so well. Is it possible that draining all this bile into the stomach assists the liver in the restoration of normal function?

Case III. Common duct stone illustrating the type of case in which there is practically no jaundice, but severe chills.—A physician, aged sixty-one, came to the Clinic for examination January 16, 1925. An appendectomy had been performed in 1903 and the patient had been in good health until September 16, 1924, when he was suddenly seized with severe colic-like pain in the right hypochondrium. This lasted for about five minutes and was not followed by soreness or jaundice. A second attack occurred October 16. Two days later he had a violent chill, followed by extreme prostration and a temperature of 103°. He had another chill the next day, associated with pain in the right hypochondrium, radiating to the back, that lasted for two days. This was followed by slight jaundice. He had twelve subsequent mild attacks until December 1, when there was a recurrence of pain associated with nausea, vomiting, and extreme prostration. This was followed by many milder attacks, in some of which slight jaundice was present.

Physical examination showed a well-nourished man, weighing 169 pounds. There was no evidence of jaundice. The systolic blood pressure was 138, the diastolic 80. The urinalysis was negative. The hemoglobin was 80 per cent, leukocytes numbered 8,500, and the blood urea was 20 mg. for each 100 cc.

Operation was performed January 19, 1925. The gallbladder, which was edematous and distended, was opened and emptied of muddy bile. The common duct was explored and a nonfacetted oval-shaped stone removed from its lower end. A catheter was fastened in the common duct for drainage. The gallbladder was then removed. There was good drainage of bile from the tube for about eight days after operation and the patient made an uneventful recovery.

This case illustrates very well how a stone, probably floating about in a dilated common duct, can be the cause of severe attacks of hepatic colic associated with chills and high fever, and yet not obstruct the duct sufficiently or long enough to cause retention of bile and jaundice. Jaundice during attacks is not a sufficient basis for a diagnosis of common duct stone. The other symptoms which this patient had were characteristic. The most severe cases of chills and fever in association with stones in the duct occurred in cases in which there had been little or no jaundice. The marked loss in strength was also characteristic. In this case a choledochostomy was performed and a stone removed from the lower end of the duct. A rubber catheter was sutured into the duct for drainage. One seldom felt justified in closing the opening in the common duct without a drain.

This case illustrates very well the group in which the principal

cause of the patient's symptoms seems to be infection rather than mechanical obstruction, and free drainage of bile seems indicated. The tube is left undisturbed, the bile draining into a bottle fastened into the dressing for from ten days to three weeks, by which time the operative wound will be healed around the tube. Usually the bile ceases to drain within a few days after the tube is removed. In case infection is severe, or stones have recurred in the duct, it may be advisable to stitch a T-tube into the duct and secure free drainage in this way for several months. This procedure, as suggested by Deaver, will sometimes relieve these patients when others have failed.

If the patient is deeply jaundiced, the gallbladder is not ordinarily removed in operating on the common duct. If there is slight jaundice or none at all, it should be removed.

Case IV. Jaundice accompanied by attacks of cholecystitis.—A man, aged thirty-seven, came to the Clinic October 27, 1924, complaining of attacks of pain in the upper abdomen. His first attack came on suddenly in December, 1922, and was followed by jaundice, dark urine, and clay-colored stools. A similar attack occurred one year later. He had had several minor attacks during the last year, the last one, which occurred two weeks ago, was characterized by sudden, excruciating pain in the upper abdomen which radiated to the back, and was later followed by jaundice.

The examination revealed a well-nourished man, weighing 167 pounds. There was a moderate degree of jaundice present and moderate tenderness over the region of the gallbladder. The systolic blood pressure was 100, the diastolic 70. The temperature was normal. Examination of the urine was negative with the exception of the presence of urobilinogen. The hemoglobin was 74 per cent, leukocytes numbered 8,900, coagulation time (Boggs) was five and one-half minutes, and bleeding time, two minutes. Functional test of the liver showed dye retention 3. The serum bilirubin was 4.6 mg. for each 100 c c. A later examination of the blood showed a coagulation time (Lee) of ten minutes and forty-five seconds, blood urea was 39 mg. for each 100 c c., blood uric acid 3.7 mg. for each 100 c c., blood creatinin 1.5 mg. for each 100 c c., and the serum bilirubin, 2.9 mg. for each 100 c c. In view of the history of repeated colics and the jaundice for the last ten days, the condition was considered to be cholecystitis with probably a stone in the common duct. The patient was placed in the hospital and prepared for operation by intravenous injections of calcium chlorid.

Operation was performed November 5, 1924. Acute cholecystitis with stones in the gallbladder was found as well as very marked dilatation of the cystic duct and evidence of considerable infection. The common duct was small and no stone could be found by palpation. A moderate degree of pancreatitis was present. The gallbladder was removed, and a piece of rub-

ber tissue inserted for drainage. The patient made an uneventful recovery and was dismissed on the fifteenth day after operation.

The interesting feature of this case is that the clinical history and the examination led us to believe that we would find, besides the cholecystitis, a stone obstructing the common duct. That a stone was not found in the duct is not absolute proof that one was not there, nevertheless, from former experience with similar cases, it is quite likely that the jaundice resulted from the sub-acute infection in the gallbladder extending to the surrounding tissues, causing mechanical interference with the duct as well as infection in the parenchyma of the liver. In these cases, even if the clinical history of interference with the duct is definite it is not advisable to make an extensive dissection to expose a small normal sized common duct. If a stone of sufficient size to cause obstruction is present, the duct will be dilated; a very small stone is certain to pass. Irreparable damage may be done to a common duct under these conditions and it is better to avoid this even at the expense of a second operation. Usually the trouble is essentially one of cholecystitis and will be entirely and permanently relieved by excision of the gallbladder. This patient's symptoms, including the jaundice, were promptly relieved by the removal of the infected gallbladder, and he has remained free from distress to the present time.

Case V. Recurring symptoms due to hepatitis and pancreatitis—A man, aged forty-four, first came to the Clinic January 12, 1918. During the previous fifteen years, he had had several attacks of severe colic in the right hypochondrium. He had never been jaundiced. He had the appearance of being quite ill and was very tender over the region of the gallbladder.

Operation was performed January 12, 1918. There was a great amount of edema about the gallbladder and common duct, the glands were very much enlarged. The gallbladder which contained many stones was removed. The appendix was also removed. Drainage was provided for by rubber tubes and a strip of gauze.

The patient returned for examination October 21, 1924. He said that very soon after his operation he began to have attacks of colic in the right hypochondrium which recurred at intervals of from three to six months. Most of these attacks were followed by jaundice, light colored stools and dark urine. He had had no fever. The last attack occurred six days before coming to the Clinic. Examinations of the urine and blood were negative. A diagnosis was made of cholangitis and probable stone in the common duct.

Operation was performed October 22. The common duct was slightly larger than normal. The regional lymph nodes were very markedly enlarged and there were many adhesions. The common duct was opened and explored, and a good-sized scoop passed easily into the duodenum and up into the hepatic ducts without meeting obstruction. There was no evidence of stone. A rubber catheter was fastened into the common duct for drainage. Good drainage of bile occurred for eight days after operation. The tube came out on the tenth day and the wound healed without incident. The patient recovered uneventfully and left the hospital on the sixteenth day after operation.

This patient represents a rather small group that has been the cause of a great deal of worry and study. At the time of his first operation, in spite of the absence of clinical signs of common duct stone, a careful examination of the duct was made which seemed to exclude the possible presence of a duct stone. Not long after the operation he began to have attacks similar to those experienced before, except that these attacks were accompanied by slight jaundice. Naturally it was feared that a stone in the duct had been overlooked. At the time of the second operation, although the duct was opened and a scoop passed throughout its entire length, no calculus was found. A stone might be overlooked under these circumstances if it slipped up into the liver during manipulations, but the same conditions have been experienced in over thirty cases, and it is not likely that the stone would be missed in such a large group. It is quite probable that at the time of the first operation the infection in the liver and pancreas had reached a point where removal of the gallbladder would not clear it up. If the condition were always recognizable, perhaps drainage of the common duct at this stage would control it, but usually, because of the edematous tissue and small caliber of the common duct, it is difficult to accomplish drainage without injuring the duct. Neither does it seem advisable to drain the common duct with each cholecystectomy in order to avoid having this small number of cases treated further.

In most cases presenting these clinical manifestations a stone will be found in the duct at the second operation. Cases in which no stone is found will be relieved by prolonged drain-

age, which clears up any infection in the liver or pancreas, or both

Case VI Cholelithiasis in a child.—A boy, aged eight, was brought to the Clinic in May, 1923, on account of repeated attacks of severe epigastric pain. At the age of three years he had begun to have sudden pain in the upper abdomen, which occurred about every three or four months, at any time of the day or night. As he grew older, the attacks became very severe, the pain was colicky, sharp and stabbing, and sometimes dull. It also increased in frequency, occurring five or six times in twenty-four hours. The pain was not related to food. There was no nausea or vomiting, no fever or jaundice.

Neurologic examination was negative. The child weighed 45 pounds and apparently was underdeveloped. The edge of the liver was about 1 cm. below the costal margin. Urine, blood, gastric contents, and stools were normal. The blood Wassermann and von Pirquet tests were negative. There was an area of healed tuberculosis in the upper lobe of the left lung. It was thought that the condition might be due to some form of congenital internal hernia.

The patient was permitted to go home. He returned in November, 1924. Since the previous visit he had had three series of attacks. For three days before the first he had complained of epigastric distress, followed by severe pain. The latter occurred several times a day and lasted from thirty minutes to two hours. During the attacks he was doubled up with pain, and sought relief by getting on his hands and knees and pressing his abdomen against a pillow. The last attack had occurred three weeks before. There were no unusual physical findings at this time. The laboratory examinations were repeated and again were negative. An additional roentgenogram of the kidneys, ureters, and bladder was also negative. Operation was advised because of the probability of an internal hernia.

At operation, November 24, 1924, there was no evidence of any type of internal hernia. The gallbladder was distended, very tense, and presented a dumb-bell deformity. The liver and pancreas were in good condition. The gallbladder was drained by trocar and cannula of a clear watery fluid without bile. It was then opened, and a quantity of black stony material was revealed. As the gallbladder was partly buried in the liver, it seemed inadvisable to remove it at this time. A dressed tube was inserted for drainage. The appendix was removed.

The condition was believed to be one of hydrops of the gallbladder with stones, the result of chronic cholecystitis with stricture or stenosis of the cystic duct. The patient recovered uneventfully. At no time did bile drain from the tube in the gallbladder. After the tubes were removed the dressings were occasionally bile stained. The gallbladder may have to be removed later.

This boy, eight years old, is the youngest child operated on here for cholecystitis with stones. Most of the cases in children that we have seen have been in females, and usually they have been atypical. Several young girls having enlarged spleens have also had stones in the gallbladder; in nearly all, the history has been suggestive of cholecystitis.

This case is interesting from a diagnostic standpoint. Undoubtedly in the case of an adult patient with this history, one of the first suspicions would have been directed to the gallbladder, but in view of the fact that we had not seen gallstones in so young a male, and that the symptoms had existed practically from birth, it was somewhat surprising to find gallstones. It is clear that severe abdominal pain in a young child may mean the presence of gallstones.

both sides. Specimens of urine from the ureter contained a small amount of pus and an occasional red blood cell from the left side, whereas that from the right side was normal. Pyelo-ureterogram (Fig. 253) of the left side showed the outline of a normal renal pelvis. The ureter was moderately dilated throughout its upper two-thirds, there was a sacculated dilatation, 2.5 cm. in diameter, in the lower third, extending to the bladder wall. The original shadow was included in the dilatation of the lower left ureter. A diagnosis was made of stone in a sacculated lower left ureter just above the bladder wall, and mild left renal infection.



Fig. 253—Pyelo-ureterogram showing a fairly normal outline of the pelvis, dilatation of the upper two-thirds of the ureter, and a sacculcation in the lower third, the original shadow is included.

A low left median rectus incision was made, exposing the lower part of the ureter extraperitoneally. On palpation, a stone could be felt just above the bladder. The ureter above the stone was greatly dilated. An incision was made in the ureter and the calculus removed without difficulty. Because of the small caliber and thickness of the ureter below the site of the stone, an attempt was made to pass a small probe downward into the bladder, but this was not successful. The ureter was closed with interrupted fine catgut sutures.

This case presents a typical history of urinary calculus. It is noted that the patient's infections began only a few years prior to the onset of his urinary symptoms and that since that time he had had influenza and quinsy. The pain during these attacks was typical, but there was also pain radiating to a definite point, which was localized in the left lower quadrant of the abdomen. Pain in this location occurs only in about 10 per cent of cases. It is quite apparent that the obstruction to the urinary flow was responsible for the severity of the attacks. There was a marked dilatation of the ureter above the stone which shows that obstruction had existed. There were also secondary inflammatory changes in the ureter around the site of the stone. As Braasch has pointed out, these changes in the ureter are secondary only to obstruction in producing pain. The patient recovered uneventfully and returned home on the twenty-first day after operation. Roentgenograms of the kidneys, ureters, and bladder, taken prior to departure from the Clinic, were negative.

Case IV. Stones in the bladder.—This patient, aged fifty-five, had always been well, save for appendicitis in 1911, for which he was operated on with complete recovery, until four years before when he began to have a dull pain in the perineum. At the same time he noticed a small amount of blood in the urine for a few days. He then had dysuria, frequency, and burning at irregular intervals, the urine occasionally being bloody. A year after the initial symptoms, he passed gravel and shot-like stones in the urine. One stone was "the size of a pea." He gradually became worse, with recurring attacks of dysuria, increased frequency, burning, and occasionally severe sharp shooting pains originating in the region of the bladder and radiating downward into the genitalia. He had consulted many physicians without obtaining relief. Repeated roentgen-ray examinations had been negative except on one occasion, when he was told he had prostatic stones. Attempts at cystoscopic examinations had been unsuccessful because of the extreme sensitiveness of the urethra.

The patient weighed 195 pounds and appeared in good physical condition. The prostate gland was moderately enlarged, soft, and very tender. The blood count was normal and the Wassermann reaction negative. The urine contained a small amount of albumin, a few red blood cells, and much pus. The combined phenolsulphonephthalein return was 25 per cent in one hour and fifteen minutes, and the blood urea 34 mg. Roentgenograms disclosed two large stones in the bladder area (Fig 251). In view of the patient's previous intolerance to cystoscopy, this procedure was not attempted.

This patient presented a history of vesical irritation, of relatively long duration, with occasional slight hematuria for brief periods. The condition had been growing progressively worse. The history of passing gravel and stones three years before, and the progressive course of the trouble, constituted presumptive evidence of a stone or stones somewhere in the urinary tract. The roentgenogram gave positive evidence of stones in the bladder, and suprapubic cystostomy was advised.

The bladder was exposed by a suprapubic incision and opened. The prostate was found to be enlarged 2, bilaterally, intravesically, and medially,



Fig. 254—Roentgenogram showing stones in the bladder area

and there was slight prostatitis, and slight cystitis. The stones, 2 cm. in diameter, were removed and prostatectomy done, the prostatic capsule afterward being packed with iodoform gauze and a No. 30 French catheter inserted to drain the bladder. The gauze pack was loosened on the third day after operation, and removed twenty-four hours later. The suprapubic catheter was removed on the eighth day after operation and a smaller one substituted. Four days later this was removed and a urethral catheter used until the suprapubic wound no longer drained urine. The urethral catheter was tolerated without difficulty in spite of the fact that intra-urethral instrumentation had been impossible before operation. The patient returned

home on the twenty-third day, feeling better, he said, than he had for three years

It is impossible to determine how long these stones had been in the bladder. Such stones undoubtedly can exist for years without presenting symptoms. They are predominantly found in males of the prostatic age. When in females or young adult males without residual urine, their origin is practically always renal. Residual urine follows prostatic hypertrophy, favors infection, stagnation, and ammoniacal decomposition with the deposit of urinary crystals. That the stones can form fairly rapidly is shown by the crystalline deposit on any indwelling catheter, which provides the necessary nucleus for the deposit of urinary crystals, as does the organic matter produced by infection. The removal of stones from the bladder and prostate simultaneously is generally conceded to increase the risk, particularly in cases of marked cystitis with considerable or slight impairment of the renal function. Since, as a rule, these patients do not tolerate preliminary preparation by an indwelling catheter, they should be operated on in two stages. When patients have very little infection and normal renal function, the one-stage operation results in very little or no increase in the mortality.

Case V. Prostatitis with stones.—A man, aged fifty, came to the Clinic because of difficulty of urination. In 1893, he contracted gonorrhea which apparently disappeared after a few weeks' treatment. Two years later, he began to have frequency, dysuria, and a distorted stream of urine. Repeated urethral dilations were necessary in the ensuing years, and during the last year the patient had used the urethral sounds himself. A physician advised the discontinuance of this practice, but this soon resulted in difficulty in passing urine. The home physician irrigated the bladder frequently and told the patient he had cystitis.

On examination the patient was rather thin, weighing 139 pounds. He had moderate dental caries, and definitely septic tonsils. On rectal examination the prostate was found to be moderately enlarged, somewhat irregular, very firm and tender, and crepitation was elicited. The urine contained only a few pus cells. The phenolsulphonephthalein return was 50 per cent, and the blood urea was 30 mg. in 100 c.c. The blood count was normal and the Wassermann reaction negative. Roentgenograms of the kidneys, ureters, and bladder disclosed multiple stones in the prostatic region (Fig 255), and cystoscopic examination disclosed a marked urethritis, multiple strictures, fulness in the prostatic area with infection, and many cicatricial

tags There was extreme trabeculation of the mucosa of the bladder and mild, chronic, diffuse cystitis.

This case typifies the sequelae of a gonorrheal infection and of repeated instrumentation for urethral strictures. Although definite oral and tonsillar sepsis was present, the years of urethral manipulations would entirely explain the urethritis, prostatitis, and cystitis. Our diagnosis was multiple strictures of the



Fig. 255 —Roentgenogram showing multiple stones in the prostate

posterior and prostatic urethra, chronic prostatitis with multiple stones, enormously dilated prostatic ducts, and chronic diffuse cystitis in a very trabeculated bladder. Suprapubic prostatectomy was advised

The bladder was exposed and opened through a suprapubic incision. The prostate was chronically infected and full of small stones and sand. The bladder was moderately dilated and there was a moderate degree of cystitis. The prostate was

removed and the prostatic capsule packed with iodoform gauze. The bladder was closed and a No. 30 French catheter used as a drain. Except for a mild epididymitis, recovery was uneventful, and the suprapubic wound closed without difficulty.

Prostatic calculi are really complications arising in cases of prostatitis and prostatic hypertrophy. As a rule, it is not the prostatic stones that cause the patient to seek relief, but the symptoms of inflammation in the prostate, or of prostatic obstruction. Pain may be an outstanding feature and is often very severe. There may be a sense of weight in the perineum or rectum, and at times the pain is referred to the anus, penis, scrotum, suprapubic area, or down the thighs. On rectal examination, the prostate is often very tender, hard, or firmly lobulated, and moderately large stones are easily felt in it. Crepitation, when present, as in this case, is pathognomonic. Previous gonorrheal infection as well as urethral stricture is a common associated condition, and in the case reported there was a history of gonorrhea with subsequent formation of strictures requiring frequent dilation.

Kretschmer says that a definite diagnosis can be established in all cases of prostatic stones by the roentgenogram. In case the roentgenograms reveal suggestive shadows over the prostatic area, it has been the practice in the Clinic to differentiate this condition from small stones in the bladder by means of cystoscopy or a cystogram.

True prostatic stones formed in the acini or ducts must not be confused with false prostatic stones, which usually arise in the kidney or bladder, and pass down and become lodged in the prostatic urethra. True prostatic calculi may be small or quite large. Although usually they are multiple, occasionally they are single. MacKenzie and Seng recently reported a case in which a single large stone had replaced the prostate gland. In all probability, stones in the prostate are due to a low-grade infection in the acini or ducts, with a deposit of various kinds of urinary salts around prostatic concretions, possibly small bits of necrotic tissue or inflammatory exudate. These salts are usually the phosphates, oxalates, or carbonates of calcium.

Prostatitis with stones is probably entirely a surgical condition. One may temporize by treating expectantly with massage and irrigations, but the patient will eventually come to operation in most instances. The prostate, which is usually completely destroyed and functionless, should be removed by the intravesical route, thus eliminating the pathologic conditions and minimizing the possibilities of recurrence.

Case VI. Urethral calculus.—A man, aged forty-three, came to the Clinic December 9, 1925, because of a rupture. He had had a sore on the



Fig. 256—Roentgenogram showing stone in the urethra

penis and gonorrhea in 1915, and sounds had been passed. One year before examination, he had noticed a lump in the left groin which was painful on straining. For the last two years he had had to urinate once at night. There had been no difficulty and the stream was normal.

Examination revealed a small right inguinal hernia, a slightly enlarged prostate, and an oval mass measuring about 5 by 3 cm., stony, hard, and movable, located anterior to the prostate in the perineum. The urine contained pus 3, and the phenolsulphonephthalein return was 50 per cent. The

blood urea was 32 mg. for each 100 c.c. Roentgenograms of the kidneys, ureters, and bladder revealed a dense shadow behind the symphysis and a deformity of the first lumbar vertebra, suggestive of an old fracture (Fig. 256). Cystoscopy was attempted, but an impassable obstruction was met in the posterior urethra which gave a definite grating sensation. A urethrogram revealed the shadow to be included in the urethrographic medium (Fig. 257).



Fig. 257.—Urethrogram showing the bulbous urethra greatly dilated, and the original shadow included.

This case is peculiar, in that the patient had had few or no urinary symptoms, and no signs of urinary obstruction. The stone was probably lying in a diverticulum of the urethra in such a position that there was no obstruction to the urinary flow.

At operation the calculus was removed through a longitudinal, median, perineal incision. The stone was in two parts, each distinctly faceted on the other (Figs. 258, 259). Both stones were removed intact. A No. 18 French catheter was passed into the bladder and the urethra reconstructed over it; an at-

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which will satisfy all conditions. Keyser, by feeding animals with oxamid, succeeded in producing sand or true calculi in the kidney or ureter in 75 per cent of experiments, but in this case we were probably dealing with a process secondary to an abnormal condition which caused disturbance of the normal colloid-solution mechanism in the urine. These abnormal conditions may be, for instance, a bacterial product within the urinary tract, or an excessive excretion of some crystalline substance which is not normal in the urine of human beings. Rosenow and Meisser have reproduced nephrolithiasis in dogs by devitalizing and infecting their teeth with an organism isolated from the urine and foci of infection of patients suffering from renal stones. The same organism was subsequently isolated from the kidneys, stones, urine, and teeth of the animals injected, and moreover, the organism was isolated from the exact location where crystallization and stone formation began. The stones which were produced in the animals had physical properties and chemical composition similar to those which are found in man. It is entirely possible that the urinary tract is actually infected, and the normal colloid balance of the urine is altered, after which there is an excessive excretion and chemical precipitation of the urinary crystalloids. Dr. C. H. Mayo thinks that nephrolithiasis is due to a dual infection, a primary hematogenous infection in the kidney, and a secondary infection from a local source, that this secondary infection is the stone-forming one, and that it must come in contact with an inflammatory exudate caused by the infection of hematogenous origin.

Hematuria, in cases of urinary calculus, as a rule, is not common and is of secondary importance to the pain experienced by the patient. Why certain stones cause bleeding and others do not is difficult to explain. Hematuria is sometimes the chief complaint, and there may be little or no pain. In such instances malignancy must be suspected. Hematuria, in the presence of a stone, may be due to an infection of the mucous membrane around the site of the stone. It is well to remember that a neoplasm may develop secondary to a stone, and cause hematuria,

which is usually greater in amount than that produced by urinary calculi.

Recurrences following pelviolithotomy have been noted in about 10 per cent of cases, in some instances probably due to small fragments of stone or a small stone which was overlooked at the time of operation. Recurrences seem to follow the removal of a single stone more frequently than of multiple stones, and also the removal of small stones more than of large ones, probably because the stone was removed during the stone-forming period of the kidney. It is interesting to find that the recurrence of stones following nephrolithotomy is twice as common as recurrences following pelviolithotomy, and recurrences in cases with bilateral stones is twice as common as in unilateral cases.

When the parenchyma of the kidney had been destroyed to such an extent that a nephrectomy was performed, recurrence of stones in the remaining kidney was very infrequent. There seems to be a close anatomic connection between the two kidneys, and the one which contains stones may become a focus of infection for the opposite kidney. Probably this accounts for a larger percentage of recurrences in the second kidney after a stone has been removed from the first, than following a nephrectomy for stone. The comparison may be analogous to a unilateral renal tuberculosis which sooner or later may act as a source of infection for the other kidney. Often in a case of bilateral renal tuberculosis in which one kidney is practically destroyed, its removal is followed by a marked improvement in the remaining kidney. The only logical explanation would be that the gross infection had been removed by nephrectomy.

In cases of bilateral nephrolithiasis the question arises as to which side to operate on first. In our experience the better kidney should, as a rule, be operated on first, and later the other kidney can be operated on, or removed if necessary. There is always a certain number of cases in which the function of the kidneys is so reduced that any operative procedure would be contraindicated. This, however, is exceptional, as most patients with bilateral nephrolithiasis should be operated on.

Hinman has shown that in case one kidney has been badly damaged, the opposite kidney undergoes a compensatory hypertrophy, and if the diseased kidney is not removed, the healthy kidney eventually takes over the entire renal function, while the impaired kidney gradually atrophies, eventually to disuse. Therefore, in cases in which one kidney is badly damaged, the good kidney should be treated first, so as to allow it to resume its former function and to hypertrophy, and also, to take advantage of the remaining parenchyma in the diseased kidney to tide over the additional strain of the operative period.

The posterolateral incision gives the best exposure for operations on the kidney and upper ureter. It is carried well forward and posteriorly, cutting the quadratus and erector spinæ muscles, and if necessary the costovertebral ligament. Good exposure in the male is much more difficult than in the female, because of the greater muscular development and also because the distance is less between the crest of the ilium and the costal margin.

For several years we have used the fluoroscope in the operating room for the localization of stones difficult to find at operation, and also to insure removal of all stones or any possible fragment which might otherwise remain. In this way we believe that we avoid a great deal of trauma to the renal parenchyma, which would undoubtedly occur while exploring for a stone not easily located by other methods. By the use of the fluoroscope we have reduced the number of apparently recurrent stones, many of which were actually stones overlooked at the time of the primary operation.

Most ureteral calculi pass spontaneously or can be removed by cystoscopic manipulation. Thomas gives the number as 90 per cent. While no set rules can be laid down, it is wise to wait, keeping the patient under close observation, or to attempt manipulation according to the location of the calculus, if the latter is of recent origin, not acutely obstructing, and small enough to pass. In those cases of fairly long duration, with the stone 2 cm. or less in diameter, dislodging the stone by the passage of a single catheter will often cause it to pass spontaneously shortly afterward. This failing, if the renal function is

not reduced and no acute infection is present, further manipulation is advisable.

In all cases an interval should elapse between cystoscopy and operation to allow for the possible passage of the stone. A roentgenogram should be taken as a routine the day of the operation, to insure the presence and exact location of the stone at that time.

Ureteral calculi are most commonly found in the lower third of the ureter. Braasch published a report of 214 cases with the location demonstrated at operation. He found twenty-six cases at the ureteropelvic juncture, twenty-eight in the upper third, one in the middle third, and 159 in the lower third of the ureter.

Stones in the ureter should always be removed extraperitoneally. The choice of approach depends on the situation and also on the preference of the surgeon. While every case should be judged individually, a rough division of the ureter may be made at the level of the brim of the pelvis. All stones lying above that level should be approached by a posterolateral incision, and those lying below it, by a low right or left rectus incision, depending on the side on which the stone is located. The ureter should be closed, if possible, with interrupted fine catgut sutures, since urinary drainage only invites infection. It is not always possible or advisable in cases with marked peri-ureteritis actually to suture the ureter, and, in this event, suturing the peri-ureteric tissues is often sufficient to prevent urinary drainage.

THE MANAGEMENT OF LESIONS OF THE STOMACH AND DUODENUM

DONALD C. BALFOUR

Each year the surgical treatment of diseases of the stomach and the duodenum shows, in some respects, definite progress. Much of the recent advance in the efficient management of gastric and duodenal disorders has been due to: (1) Increasing ability to detect existing disease processes; (2) better interpretation of the significance of the clinical findings; (3) better judgment in deciding on the management of the complicated cases; (4) quick recognition and control of serious complications, particularly gastro-intestinal stasis; and (5) increasing experience in the operative treatment of surgical lesions. The cases reported here, in which operation has been performed recently, illustrate some of these points.

Case I. Gastric polyposis and gastric ulcer.—A woman, aged sixty, registered at the Clinic January 8, 1925. She had been perfectly well until a year before admission when she experienced sudden pain and distress in the right upper quadrant which radiated to the epigastrium. The pain lasted about five minutes, and was followed by nausea and vomiting. There was no residual soreness. Her skin and sclerotics became yellow the next day and remained so for three days. Since then her stomach had distressed her occasionally, nausea came on an hour after each meal, particularly after eating meat or greasy food. Soda or vomiting relieved her at once. At times she had a hunger pain which was relieved immediately by eating. She had no pain at night, but there had been frequent sour eructations. A month before admission she had had an attack, similar to the first one but not so severe, which also lasted only a few minutes. There were no urinary symptoms.

Examination revealed a movable mass in the right flank, which was apparently a kidney. The history was suggestive of gallbladder disease, but more careful consideration of the condition between the two attacks of severe pain suggested a lesion of the stomach. A roentgenologic examination revealed a "lesion at the outlet of the stomach," and a large shadow in the right kidney. The specific gravity of the urine was 1.019; it contained pus 4

The hemoglobin was 72 per cent, the blood Wassermann reaction was negative; gastric analysis revealed total acidity 22, and free hydrochloric acid 10. The patient was advised to have a gastric operation first, and a nephrectomy later.

On exploration a soft movable tumor, 7 cm. in diameter, was found at the pyloric end of the stomach. The tumor could be invaginated into the duodenum, and because of its mobility and soft character it was believed to be benign. There was also a small gastric ulcer, the crater of which was about 1 cm. in diameter, on the posterior wall of the stomach, near the lesser curvature, and about 7 cm. from the pylorus. Because of the double lesion it seemed advisable to perform a partial gastrectomy. This was done by the posterior Polva method. Pathologic examination of the specimen revealed



Fig. 260—Specimen showing gastric polyposis and benign gastric ulcer

a gastric polyposis, and benign gastric ulcer (Fig. 260). The polypoid condition involved an area on the posterior wall of the stomach about 5 cm. in diameter, there was sufficient pedunculation of this mass to permit its invagination into the duodenum, but the duodenal mucosa was not involved. There was no evidence of malignancy.

The patient recovered uneventfully from the operation, and three weeks later a nephrectomy for pyonephrosis with nephrolithiasis was performed, from this she also convalesced satisfactorily.

The preoperative diagnosis in cases of gastric polyposis of this degree can only be made by the aid of the Roentgen ray;

only two cases have thus been correctly diagnosed in the Clinic. In fact, only four cases have seemed worthy of classification as gastric polyposis in 15,000 cases of lesions of the stomach and duodenum in which operation was performed. In one case operated on in 1918 more than 250 polyps were counted. The condition should not be confused with malignant papillomatous masses occasionally encountered.

The next case is one which illustrates the unsatisfactory results of an operation which now is considered obsolete, namely, the gastroduodenostomy of Kocher.

Case II. Unnecessary gastroduodenostomy.—A man, aged thirty-eight, came to the Clinic October 15, 1924, complaining of stomach trouble. For twenty-one years he had had spells of epigastric distention, associated with

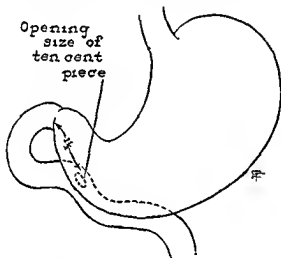


Fig. 261.—Unnecessary gastroduodenostomy with opening 3 cm from pylorus

vomiting which usually gave him relief. These attacks came on every two or three weeks and were at times accompanied by indefinite abdominal distress which lasted a few days and cleared up after a spell of vomiting. During the last five years the attacks of distress had become more marked and were definitely localized in the epigastrium. They usually occurred in the evening, but occasionally after the noon meal. Food, liquid, and soda gave no relief, but only emesis, either induced or spontaneous. At times he had vomited food taken as long as three days before. Three years before admission, a gastro-enterostomy had been performed elsewhere for a sclerosing and deforming ulcer near the pylorus. Following this operation he was greatly improved but not cured. The marked retention was relieved and the attacks

of vomiting were much less severe and less frequent. The spells of distress continued, however, seemingly independent of food, usually starting in the morning at eleven o'clock and lasting until he lay down. Lying on his right side always relieved the distress, soda gave relief for only a few minutes. He had lost no weight recently.

Examination showed gastric retention of 230 c c, and the x-ray revealed an obstructive lesion at the outlet of the stomach, but no relic of a gastro-enterostomy was seen. Operation was advised.

Exploration revealed a very much enlarged stomach but no evidence of a gastro-enterostomy. There were many scarred areas on the anterior wall of the duodenum, which, however, could not account for the amount of obstruction. A posterior gastro-enterostomy seemed advisable, but, because of the obliteration of the right half of the lesser peritoneal cavity by adhesions, it would have been necessary to make the anastomosis high on the stomach, and a partial gastrectomy appeared to be preferable. When the pyloric end of the stomach was mobilized, a union between the stomach and the third portion of the duodenum was found at a point about 2.5 cm. from the pylorus (Fig. 261). This was disconnected, the opening in the duodenum closed as carefully as possible, the peritoneum closed over it, and a partial gastrectomy performed by the posterior Polya method. The operation was performed under difficulties on account of the many adhesions. The patient recovered uneventfully and was completely relieved from symptoms.

This case is of particular interest because it recalls one of the early methods devised for the treatment of duodenal ulcer: that is, an anastomosis between the pyloric end of the stomach and the third portion of the duodenum. The original operation has usually been attributed to Kocher, but one finds, as usual, that others, including Jaboulay, and Kummell, have described a more or less similar operation. Why this operation was performed in this case is problematic. Possibly there appeared to be some reason why the first part of the jejunum could not be used, while an anastomosis between the pyloric end and the dilated retroperitoneal duodenum was a comparatively simple procedure. An anastomosis in this situation could not function satisfactorily, if for no other reason than that it could not be made large enough. At the time of operation the opening was only about 2 cm. in diameter, and the x-ray failed to reveal it. As has been noted in the description of the findings at operation, the stomach was greatly dilated, and yet there was no corresponding contracture at the pylorus. It may be assumed, then, that the obstruction was due to physiologic rather than anatomic

causes. Another interesting feature of the case is that, because of the situation of the original anastomosis, and the veil of extensive adhesions, it was almost overlooked. Indeed, it probably would have been had not a resection of the stomach been decided on.

Case III. Partial gastric exclusion.—A man, aged forty-one, registered at the Clinic January 28, 1925. For thirty years the history had been typical of ulcer. As a child he had had intermittent attacks of stomach trouble, and as the years went on, the duration of the attacks became longer. The pain and distress occurred when the stomach was empty and he felt much worse after eating sour or greasy food. In November, 1921, he had had a great deal of pain, followed by nausea and vomiting with hematemesis and tarry stools. He became very weak and was in bed for several weeks. The pain was absent for a long time after the hemorrhage. He lived on a Sippy diet for months, and even after it was discontinued he felt quite well until October, 1924, when there occurred a short period of mild distress followed by weakness and tarry stools. He was in bed again for several weeks, and although he was very careful of his diet, he had more or less discomfort of the ulcer type after the beginning of November, 1924.

When examined at the Clinic no definite abnormality could be seen or palpated in the abdomen. The roentgenogram revealed a duodenal ulcer with obstruction. The specific gravity of the urine was 1.023, and it contained pus 1, the hemoglobin was 74 per cent; the blood Wassermann reaction was negative, gastric analysis revealed total acidity 102, and free hydrochloric acid 80.

At operation the patient was found to have such an extensive lesion of the anterior wall of the duodenum that local excision was out of the question. Because of the repeated hemorrhages by mouth and by bowel it was imperative that the greatest possible certainty of complete and permanent healing of the ulcerated area should be assured to prevent further bleeding. I, therefore, completely excluded the pyloric end of the stomach and the duodenum by the method described by Devine.

Although this is a type of case in which excellent symptomatic results have followed gastro-enterostomy, experience has shown that the indirect operation for the bleeding type of duodenal ulcer is followed by recurrence of hemorrhage in 12 to 15 per cent of cases. In this case the lesion was so extensive that there was no reasonable possibility of excising it. Devine's method of performing a partial gastric exclusion consists of a complete division of the stomach (Fig. 262), high enough so that the emptying time is rapid, and the acidity unfailingly lowered.

The end of the pyloric segment is closed in the usual way and the end of the upper segment of stomach anastomosed to the jejunum as a posterior Polya operation (Fig. 263). Devine has shown that in such cases the gastric analysis is even better than after partial gastrectomy. He attributes this to the possibility that the pyloric stump of the stomach which is re-



Fig. 262.—Devine's method of performing partial gastric exclusion

tained, aids, both by its propelling power and by its alkaline secretion, in the alkalization of the contents of the stomach. The operation is no more difficult than gastro-enterostomy, and I have performed it in a number of cases, with excellent immediate results. Whether there is a greater liability for jejunal ulcer to develop after this type of operation than after an ordinary gastro-enterostomy remains to be seen, but if the division is

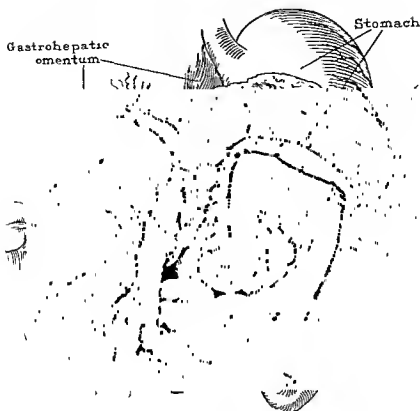


Fig. 263.—Devine operation completed.

made high enough on the stomach the possibility is probably no greater.

Case IV. Two-stage operation for large gastric ulcer complicated by toxemia of stasis.—A man, aged thirty-nine, first registered at the Clinic January 30, 1924. He had been having periodic attacks of stomach trouble since 1921, usually after dietary indiscretion and following meals. In May, 1922, he had an attack lasting three weeks, accompanied by pyrosis, belching, regurgitation, and constipation. Milk, cream, and soda afforded some relief. He had a remission from June until December, 1922, and then began to have daily distress after meals. Nocturnal pain was relieved by alkalis. He had another remission from January, 1923 until May, 1923, and since then has had periodic attacks of distress until the present time.

Examination revealed a perforated gastric ulcer with retention. The specific gravity of the urine was 1.013; it contained pus 1; the hemoglobin was 72 per cent; the blood Wassermann reaction was positive according to the Kolmer technic, and gastric analysis revealed total acidity 68, and free hydrochloric acid 32.

On exploration in February, 1924, a perforated gastric ulcer and sub-

acute appendicitis were found. The ulcer was situated about 10 cm from the pylorus, the crater was entirely on the posterior wall, and, from that point to the pylorus, the lesser curvature and the posterior wall presented much more thickening than the average ulcer occasions. This formed a distinct mass, and may have had some association with the patient's active syphilis. The extent of the induration and the extragastric inflammatory products precluded a partial gastrectomy and it seemed advisable to destroy the crater of the ulcer as thoroughly as possible, by the cautery, and to follow this with a gastro-enterostomy in the hope that the combination of partial removal of the lesion with adequate drainage would promote complete healing.

For about eight months the patient was completely relieved of his symptoms, and followed a postoperative ulcer diet. Early in September, he had a recurrence of the same epigastric distress. The attacks of pain oc-

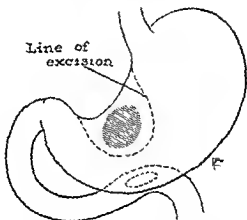


Fig. 264 —Ulcer on posterior wall to be excised secondary to gastro-enterostomy

curred from two to three hours after meals, and they were immediately relieved by a drink of milk. Examination disclosed a perforation of the ulcer at the former site. The laboratory examinations had not changed except that the gastric analysis revealed total acidity 96, and free hydrochloric acid 74.

A second exploration was made October 25. There were extensive adhesions of the stomach to the liver and abdominal wall, and a mass of induration 8 cm. in diameter was found just above the pylorus and attached to the pancreas (Fig. 264). The gastro-enterostomy opening was large, and because of the induration around the pyloric end of the stomach and duodenum a partial gastrectomy would have been unwise. An incision, therefore, was made in the anterior wall of the stomach, and the ulcer, which measured 7.5 cm. in diameter, and which was firmly attached to the pancreas, was

excised. The large opening was closed with chromic catgut, leaving a thick-walled tubular stomach which was largely taken up by the gastro-enterostomy.

The immediate convalescence of the patient was what one might expect with the small, tubular, thick-walled stomach. Vomiting began and continued, in spite of repeated gastric lavage, until the patient exhibited a high degree of toxemia.

Dr. McVicar, of the gastro-enterologic service, observed the further convalescence of the patient. Delay in recovery of motor function of the gastric musculature was evidenced by the daily accumulation of fluid in the stomach. Blood chemistry studies, made on the fifth day after operation, gave laboratory confirmation of the severe toxemia present, a toxemia so severe that the patient was comatose for forty-eight hours. The extraordinary recovery from this toxemia under intensive treatment by the intravenous medication of 1 per cent physiologic sodium chlorid solution and 10 per cent glucose solution is shown in the tabulation.

ACUTE TOXEMIA FOLLOWING EXCISION OF LARGE GASTRIC ULCER

Date, 1924	Intake, c.c.					Output, c.c.			Urea, mg. for each 100 c.c.	Chlorids, mg. for each 100 c.c.	Carbon dioxide combining power.
	Proctodials	Subcutaneous	Intravenous	By mouth	Total.	Total.	Emesis.	Urine			
10/25	2500	Operation			2500						
10/26	2500				2500	750		750			
10/27	2000				2000	1170	420	750			
10/28	1500			270	1770	950	150	800			
10/29	1400			700	2100	1670	1025	670			
10/30	1000		1000		2000	1350	150	1250	292	490	62.2
10/31			1950		1950	2450		2450	240	505	71
11/ 1	500		2000		2500	1880	120	1760	140	567	68
11/ 2			3000		3000	950		950	158	635	58
11/ 3		1200	500	1970	3470			1360	83	735	58
11/ 4				2910	2010			1055	21	620	43

On November 3 a patch of pneumonia infiltration was discovered in the base of the left lung. This finding was heralded by a sharp rise in fever, rapid breathing, and herpes labialis. With the onset of pneumonia there was a rise in the blood chlorids, presumably due to the pneumonia. The patient recovered from this condition satisfactorily.

Case V. Unnecessary gastro-enterostomy with multiple operations on the stomach.—A woman, aged thirty, first came to the Clinic in August, 1924. She had had various operations, an appendectomy in 1918, a gastro-

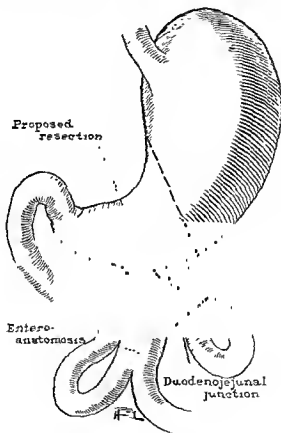


Fig. 265 —Relation of stomach and small intestine before operation

enterostomy in 1919, and following this seven operations on the stomach, including plastic operations on the anastomosis, entero-anastomosis, duodenojejunal anastomosis, and so forth. All the operations subsequent to the gastro-enterostomy had been done with the intent of relieving the patient of the vomiting of bile, but at the time of her admission to the Clinic her

chief complaint was the nausea and vomiting and the disability associated with a vicious circle syndrome.

Roentgenograms of the stomach did not reveal a demonstrable lesion and the gastro-enterostomy appeared to be free. The specific gravity of the

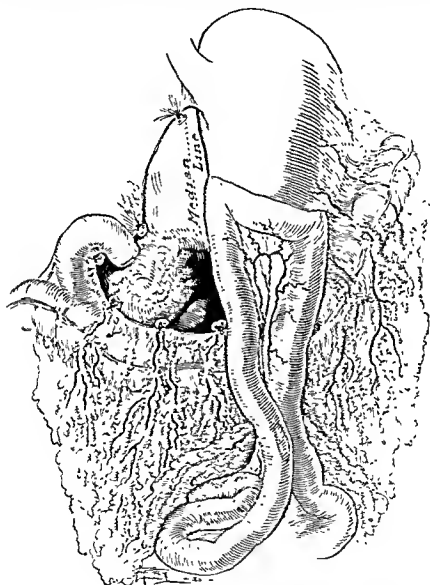


Fig 266.—Partial gastrectomy, antecolic end-to-side with entero-anastomosis.

urine was 1 010, and it contained pus 1; the hemoglobin was 79 per cent; the blood Wassermann reaction was negative; and gastric analysis revealed total acidity 22 and free hydrochloric acid 12.

It was felt that the most the patient could hope for would be a return

to the status preceding the original operation on the stomach. Operation was advised because the patient had reached a point where the vomiting of bile and distress was sufficient to warrant further exploration. So far as could be determined at operation, there was no lesion of stomach or duodenum. It was quite obvious that the gastro-enterostomy opening was not functioning (Fig 265). It was therefore disconnected, and because of the multiple deformities and anastomoses of the first few inches of the jejunum it was thought unwise to depend on this segment of the intestines to carry on normal function, and partial gastrectomy was done, the end of the stomach being united to the intestine distal to the site of the previous anastomoses. The antecolic end-to-side anastomosis was combined with entero-anastomosis (Fig 266). The patient has been completely relieved from her vomiting, and a permanently satisfactory result, so far as the functioning of the stomach is concerned, should follow the operation.

SURGICAL TREATMENT OF LESIONS OF THE HIP AND KNEE AND NONUNION OF THE RADIUS

MELVIN S. HENDERSON

Case I. Double congenital dislocation of the hips: Lorenz bifurcation operation.—The patient, an intelligent, well-developed girl, aged thirteen, came to the Clinic July 6, 1924, because of a waddling gait, stiffness of the hips, and pain on continued standing, due to congenital dislocation of the



Fig. 267.—Double congenital dislocation of the hips with obliteration of acetabulum.

hips. She had been slow in beginning to walk, and the gait had always been abnormal. No attempt had been made to reduce the dislocation.

The restriction of motion in all directions was much more marked than it usually is in this disease. The x-ray showed the heads of the femora well up on the ilium, the acetabula small and poorly developed (Fig. 267). The restriction of motion was almost complete in the left hip, and the right showed a range of motion equal to about 20 per cent of the normal in all directions. Since there was absolutely no chance of reducing the dislocations, it was best to perform some stabilizing operation, and the Lorenz bifurcation opera-

tion was chosen. This consists in performing an osteotomy of the shaft of the femur at about the level of the acetabulum and forcing the lower fragment up into the acetabulum.

July 14, through a Smith-Petersen incision, the right hip-joint was exposed and after considerable difficulty, the acetabulum was identified and an osteotomy of the femur was performed at a level opposite to the acetabulum, the line of fracture running obliquely from below upward and inward. The upper end of the lower fragment was forced into the acetabulum, care being taken to place the lower end of the upper fragment against the denuded bone on the shaft of the femur, a point emphasized by Lorenz. The leg was put up in marked abduction, in a double plaster-of-Paris spica cast extending to the foot on the right side and to the knee on the left. It was changed after



Fig. 268 —End-result of Lorenz bifurcation operation on the right hip showing upper end of femur in acetabulum

seven weeks, and the child allowed up on crutches, with a short spica cast. This cast was removed after three weeks, and the roentgenograms showed the bone to be in good position. The child was dismissed soon after, to return for the operation on the opposite hip.

When she returned March 9, 1925, the right hip was found to be quite stable (Fig. 268). Trendelenburg's sign was absent on this side, and she preferred to stand with her weight on the right leg. Motion was limited, however, although not appreciably more than before the operation.

March 12, the left hip was operated on exactly as the right hip except that as soon as the lower fragment was in the acetabulum the head of the femur was practically all removed, the trochanter and its attached muscles being spared. As in the first operation, the lower end of the upper fragment

was carefully placed in apposition to the shaft of the femur, so that union would occur, and the trochanteric muscles thus have control of the femur.

As a result of these operations, this patient will have stability in standing and walking; the weight will be borne through the hips by bony contact rather than by fibrous union. This operation should be advised in comparatively few cases of double congenital dislocation. In young children it is preferable to turn down a large shelf of bone from the iliac wall so as to furnish a bony ridge for weight bearing. In the unilateral cases in which movement is good, and there are no appreciable subjective symptoms, nothing should be done.

One unusual feature in this case was that one sister, twenty-two years old, and the father both suffer from double congenital dislocation of the hips.

Case II. Epiphyseal displacement with coxa vara; correction by osteotomy.—The patient, a boy aged fifteen, was brought for examination in January, 1924, because of pain in the right hip and difficulty in walking. Two months before, he had been awakened one morning with pain in the right hip. It was not severe enough to confine him. He continued at school, but later wrenched the hip several times, and after being about all day the pain was so severe that he had to be carried upstairs. There was nothing that could really be called trauma at any time.

The patient was mature and large for his years, but of the Fröhlich syndrome type, with the characteristic tendency to overweight, large, somewhat effeminate type of hips, and small genitalia. Mentally, he was alert and above the average. He walked with a slight right-sided limp. There was slight pain on extreme abduction and flexion, but no shortening. The roentgenogram was rather indeterminate, although there was a certain haziness of the joint line. A reduction diet was ordered, and activities were limited. He was not seen again for eight months, when the roentgenogram disclosed an early coxa vara with just a suggestion of shortening. He was seen again three months later, when the coxa vara was quite definite, there was 2.5 cm. of shortening (Fig. 269). Manipulation or an open operation was advised to restore the normal relation of the head to the neck, and to correct as much as possible the triple deformity seen in these cases of coxa vara, that is, downward displacement of the epiphysis on the neck, the anterior bowing of the neck, the relegation of the trochanter to a posterior plane with a consequent eversion of the foot.

Operation was deferred for reasons of convenience. The patient's general condition was excellent. He had lost 25 pounds, weighing 135 pounds. He returned and was operated on in January, 1925. Open operation was selected, for it was quite evident that there was firm bony union, and that

tion was chosen. This consists in performing an osteotomy of the shaft of the femur at about the level of the acetabulum and forcing the lower fragment up into the acetabulum.

July 14, through a Smith-Petersen incision, the right hip-joint was exposed and after considerable difficulty, the acetabulum was identified and an osteotomy of the femur was performed at a level opposite to the acetabulum, the line of fracture running obliquely from below upward and inward. The upper end of the lower fragment was forced into the acetabulum, care being taken to place the lower end of the upper fragment against the denuded bone on the shaft of the femur, a point emphasized by Lorenz. The leg was put up in marked abduction, in a double plaster-of-Paris spica cast extending to the foot on the right side and to the knee on the left. It was changed after

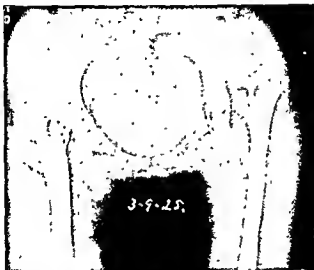


Fig. 268 —End-result of Lorenz bifurcation operation on the right hip showing upper end of femur in acetabulum

seven weeks, and the child allowed up on crutches, with a short spica cast. This cast was removed after three weeks, and the roentgenograms showed the bone to be in good position. The child was dismissed soon after, to return for the operation on the opposite hip.

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March 12, the left hip was operated on exactly as the right hip except that as soon as the lower fragment was in the acetabulum the head of the femur was practically all removed, the trochanter and its attached muscles being spared. As in the first operation, the lower end of the upper fragment

appearance of being displaced downward, but in reality it was the neck of the femur that was displaced upward. The slipping of the neck on the epiphysis had so altered the normal position that the neck looked slightly forward and was pushed upward on the head. Nature had attempted to prevent further slipping by throwing out callus anteriorly at the line of juncture, and this had a good deal to do with the anterior bowing that was present. There was a slight mushroom bulging of the epiphysis at its lower margin over the edge of the acetabulum. Osteotomy was performed through the neck at its juncture with the head, a small wedge being removed which had its base forward and upward. By manipulation and prying with the bone skids, the epiphysis was brought into normal relation with the head, and was held by forcing the leg out into extreme abduction and rotating the foot inward. A roentgenogram was taken and developed at once so that before the wound was closed the position was known to be satisfactory.

A double spica cast was applied extending from the chest to the toes on the affected side, with the leg in extreme abduction, and to the knee on the opposite side. This was worn for eight weeks, when it was removed and a roentgenogram taken, showing normal position (Fig. 270). A cast was applied extending from the chest to the toes on the affected side, the leg being still held in abduction and the foot in internal rotation. He was allowed up with crutches, but this cast will be worn for two months more, and no weight bearing will be permitted until six months from the time of operation.

It is gradually becoming the accepted opinion when adolescents of this type are concerned that it is better to perform the open operation and restore normal relations than to permit patients to go on to adult life with a permanent deformity.

Case III. Tuberculosis of the hip, primary in the acetabulum.—The patient, a boy aged eleven years, was brought to the Clinic in May, 1919, complaining of a painful left hip. Since that time he has returned at stated intervals for examination and care. Nine months before admission, he had fallen on the hip, and soon after developed a limp and stiffness, which were slight at first. His family physician applied a cast and at one time kept the boy in bed for three months. One week before admission, a fall on the hip was followed by marked exacerbation of the symptoms, so that he cried out in his sleep as though in intense pain, evidently the characteristic "night cries."

On examination the boy showed evidence of recent suffering, but his general condition was good. There was limitation of movement of the left hip in all directions. There was no actual shortening, but there was an

and a thinning of the joint line along with a flattening out of the acetabular cavity. Considered with the clinical symptoms, this evidence was sufficient to establish the diagnosis of tuberculosis of the hip, probably primary in the

acetabulum. The tonsils were large, and their removal was advised and carried out before treatment of the hip was begun. A plaster-of-Paris spica



Fig. 271.—Tuberculosis of the hip, primary in the acetabulum



Fig. 272.—Same as Fig. 271, with increased destruction of the acetabulum and adduction deformity

cast was applied, extending from the chest to below the knee. Rapid improvement followed, so that in six months it was deemed safe to replace the cast with a Thomas splint. On wearing this, however, pain returned, the

abduction deformity was exchanged for an adduction deformity (Fig. 272), and it was found necessary to resort to casts again before the symptoms could be relieved. It was thought that the patient would be better in a hospital, but, as so often happens, the parents could not afford the expense and would not consider a charitable institution. The only compromise was to carry out the treatment as well as possible during the six years that he has been under observation, at intervals of about three or four times a year. The hip was kept in good position by the use of casts, and the general depreciation in health consequent on the formation of an abscess, which drained on the outer part of the thigh, was combated by general means, such as open air, good food, codliver oil, and so forth. The abscess finally healed and apparently at this time, March 3, six years after the onset, he has ankylosis in



Fig. 273.—Same as Figs 271, 272; immature ankylosis; good position

good position. Careful study of the last roentgenogram indicates that although there is ankylosis it is still "green" and that it is too early to allow this boy to go without fixation (Fig. 273). It is encouraging to observe in the film that the hip is slightly abducted in good position, although the acetabulum is completely destroyed, that there are no signs of activity, the bony detail being more readily seen than was possible six months ago, and that there is, most important of all, increased calcification, the old osteoporotic condition being replaced by increased density. The clinical examination discloses no motion and no pain. The hip will be protected until the bony union of the head of the femur to the pelvis is clearly shown in the film by continuous bony trabeculations from the pelvis into the substance of the head of the femur. It is reasonable to believe that this will occur in this particular case because the destruction has been so extensive that the car-

tilaginous portion of the acetabulum and the head of the femur have been destroyed, leaving the cancellous bone in each in contact with the other. The boy is approaching puberty at which age bony ankylosis will occur, whereas in a child six years younger, it probably would not.

This case illustrates the low grade chronic nature of tuberculosis of the hip, and that it is not incompatible with good general health. In the child, if suitable fixation is maintained and general good care instituted, good functional results can be obtained under conditions far from ideal, and in spite of the difficulties of infrequent observations and opportunity for care. The primary abduction deformity, and later, the adduction deformity, were combated, and, even in spite of abscess formation, the ambulatory treatment was carried out.

Ankylosis is more prone to develop in the cases that have drained pus, and the dreaded abscess may occasionally be a friend in disguise. The treatment must not be stopped until clinical examination and x-ray findings positively prove that bony ankylosis is complete, or that bony ankylosis cannot be expected, in which case a fibrous one must suffice. This patient is still under care and observation six years after the first admission.

Case IV. Resection of the knee for tuberculosis, following nephrectomy for tuberculosis.—The patient, a woman aged thirty-six, first came to the Clinic in April, 1923, on account of pain in the right side of the abdomen, a stiff painful left knee, and pain in the fourth toe of the right foot. The severe right-sided abdominal pain came in spells, starting at the orifice of the urethra, and radiating up to the region of the right kidney. The pain in the right foot was due to metatarsalgia, or Morton's toe. The pain in the knee had been present for seventeen years, whereas the abdominal pain had been present for only eight years.

April 13, a tuberculous right kidney was removed. Although the trouble in the knee was of longer standing, the nephrectomy was done first because delay might permit of extension of the tuberculosis to the opposite kidney, from which normal urine had been obtained. Clinical examination and roentgenograms of the chest were negative. In spite of these two tuberculous foci, the patient's general condition was good, her weight being 155 pounds and her height, 5 feet, 5 inches. The roentgenograms showed extensive destructive arthritis of the left knee (Fig 274), and this, with the long clinical history and the removal of a tuberculous kidney, established the diagnosis of tuberculosis. The patient was allowed to go home after the neph-

rectomy and was to return as soon as she felt well enough to have a resection of the left knee. At her own request no splint or cast was applied. She returned February 26, 1925, for operation on the knee. She seemed to be in excellent health. The left knee was held partially flexed. There was local heat and swelling, most of which was due to periarticular thickening rather than intra-articular effusion. The thigh and calf were atrophied. The characteristic "spindle" knee was obscured by the well-nourished condition of the patient.

March 1, 1925, under a tourniquet, the left knee was opened wide by a transverse incision running across just below the patella, down through the



Fig. 274.—Tuberculosis of the knee with marked destruction.

capsule at the joint line and severing the patellar tendon. When the knee was acutely flexed a "dry" joint was found, there being no free pus or broken-down tuberculous débris. The patella, the suprapatellar pouch, and as much of the involved capsule as possible, were dissected out, the patella being carefully kept in warm, sterile sponges for use later as a graft. The articular surfaces of the tibia and the femur were markedly eroded and the joint cartilage practically destroyed, as were also the fibrocartilaginous semilunar cartilages. Although there was no free pus in the joint, there was an old

abscess cavity in the outer tuberosity of the tibia, and another in the outer condyle of the femur. These showed no tendency to fill in with bone, but were filled with firm gray colored fibrous tissue. About 2 cm. of the lower end of the femur and the upper 1 cm. of the tibia were sawed off so that the bones came together at an angle of flexion of about 12 or 15 degrees. The anterior portion of the lower end of the femur was freshened in the median line, as was a corresponding area on the upper end of the tibia. Through two anterolateral incisions two long wire nails were driven upward through the tibia well into the femur to provide fixation. The nails were long enough to protrude well out through the skin incision so that they could later be withdrawn, since their chief function was to prevent displacement of the bones during the application of the cast. The patella was then sawed on both sides so that the articular inner surface was entirely removed, as was also the outer fibrous side. The edges having been freshened, it made a splendid bone graft which was placed against the denuded areas previously prepared on the anterior surface of the tibia and femur. The incision was then closed with silk worm and dermal suture. No drain was inserted. A large dressing was placed around the knee and firmly bandaged. No vessels were clamped or tied during the operation, and after the firm application of the bandage, the tourniquet was removed. A plaster-of-Paris cast was applied extending from the groin to the toes. Following such a procedure, it is customary in three weeks to cut the cast on each side so that the top half can be lifted off. The leg is then gently lifted out and a new dressing placed posteriorly in the cast to replace the old blood-soaked one. The leg is put back gently at the same angle of slight flexion into the posterior half of the cast, the stitches and the wire nails removed, the latter coming out easily, without

a new cast is applied which extends from the groin only to the ankle. This last cast is worn for three months or more, when in all probability, union will be sufficiently firm to permit the wearing of a stiff-legged brace. The use of the patella or some other piece of bone secured at the time of operation as a graft very materially hastens the formation of bony union in a resected knee.

The patient went home following the nephrectomy and did not return for almost two years, hoping that the knee would improve and not require operation. It gradually got worse and she finally decided to have it treated. Chronic joint tuberculosis is rarely very painful, as is well exemplified in this particular case. Patients become so accustomed to the stiffness, soreness, and inconvenience that they drag on with the arthritis for years. It is only after they have had a resection and are free from discomfort, that they realize what an extremely trouble-

some affair the knee has been. In this type of knee the surgeon should have no hesitation in strongly urging resection.

Case V. Nonunion of the hip with total absorption of the neck of the femur: Whitman reconstruction operation.—A rather tall, thin woman, aged forty-six, came to the Clinic September 23, 1924, on account of a fracture of the right hip. In March, 1920, almost five years before, she had been in an automobile accident and had been treated in a hospital for six weeks with Buck's extension for fracture of the hip. Later an operation was performed for nonunion, and she was told that the hip was wired. The leg had been put up in abduction in a cast and left in that position for seven weeks. Following this she had been convalescent in bed, wheel chair, and so forth, for



Fig. 275 —Nonunion of the right hip with total absorption of the neck.

seven weeks. Union had failed, and she had had no return of function. At the time of admission to the Clinic, she was walking with a cane and wearing a modified Thomas hip splint.

Her general health was good. When lying down, she was unable to lift the heel off the table with the knee extended. There was shortening of 8 cm, and the x-ray disclosed a total absorption of the neck of the femur (Fig 275). The film clearly showed why she had such a degree of disability. The trochanter was impinging on the wall of the ilium, but there was nothing to stop it from riding farther up when bearing weight. Her hip was very lax and weight-bearing was evidently largely ligamentous and muscular, which could be easily demonstrated by pulling and pushing on the leg when the patient was recumbent. On account of the total absorption of the neck,

abscess cavity in the outer tuberosity of the tibia, and another in the outer condyle of the femur. These showed no tendency to fill in with bone, but were filled with firm gray-colored fibrous tissue. About 2 cm. of the lower end of the femur and the upper 1 cm. of the tibia were sawed off so that the bones came together at an angle of flexion of about 12 or 15 degrees. The anterior portion of the lower end of the femur was freshened in the median line, as was a corresponding area on the upper end of the tibia. Through two anterolateral incisions two long wire nails were driven upward through the tibia well into the femur to provide fixation. The nails were long enough to protrude well out through the skin incision so that they could later be withdrawn, since their chief function was to prevent displacement of the bones during the application of the cast. The patella was then sawed on both sides so that the articular inner surface was entirely removed, as was also the outer fibrous side. The edges having been freshened, it made a splendid bone graft which was placed against the denuded areas previously prepared on the anterior surface of the tibia and femur. The incision was then closed with silk worm and dermal suture. No drain was inserted. A large dressing was placed around the knee and firmly bandaged. No vessels were clamped or tied during the operation, and after the firm application of the bandage, the tourniquet was removed. A plaster-of-Paris cast was applied extending from the groin to the toes. Following such a procedure, it is customary in three weeks to cut the cast on each side so that the top half can be lifted off. The leg is then gently lifted out and a new dressing placed posteriorly in the cast to replace the old blood-soaked one. The leg is put back gently at the same angle of slight flexion into the posterior half of the cast, the stitches and the wire nails removed, the latter coming out easily, without pain any time after twenty-one days. A clean dressing is applied anteriorly, and a few wrappings of plaster-of-Paris run around the cast on the leg. The remodelled cast is worn in this manner for another month or six weeks, when a new cast is applied which extends from the groin only to the ankle. This last cast is worn for three months or more, when in all probability, union will be sufficiently firm to permit the wearing of a stiff-legged brace. The use of the patella or some other piece of bone secured at the time of operation as a graft very materially hastens the formation of bony union in a resected knee.

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Fig. 275 —Nonunion of the right hip with total absorption of the neck

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Fig. 276 —Illustrating the use of the fibula as a bone peg when the neck is not absorbed



Fig. 277 —Whitman reconstruction operation, suitable if there is absorption of the neck

the ordinary reconstruction operation, whereby the fibula is used as a peg through the trochanter and the remnant of the neck into the head of the bone (Fig. 276), was not thought advisable. It was decided to perform a Whitman reconstruction operation, which consists of removal of the head of the femur and a reconstruction or modeling of the upper end of the femur so that it can be placed in the acetabulum. Accordingly, November 6, through a Smith-Petersen incision, dissection was carried down on the hip-joint, and the head of the femur was removed from the acetabulum. Many adhesions were encountered which were due to the previous operation. The trochanter, with the attached muscles, was then knocked off and the upper end of the femur shaped so that it could be put into the acetabulum. The leg was then held well out into abduction and the trochanter with attached muscles was sewed down by the aid of chromic catgut to a lower level on the shaft of the femur. The wound was closed, a plaster-of-Paris cast applied from the chest to the toes on the right side, and to the knee on the left. The patient's convalescence was uneventful.

January 22, the cast was removed and left off. The measurements at that time showed an actual shortening of 4 cm. and an apparent shortening of only 1 cm., on account of tilting of the pelvis, which was an improvement on the preoperative measurements. Movements were roughly about one-third normal and the roentgenogram (Fig. 277) showed excellent position. The patient was encouraged to get about on crutches, and she left for home January 25. Function will be greatly improved, because she is now bearing weight by bony contact rather than by fibrous union.

Case VI. Nonunion of the right radius, the result of a compound fracture, with sequestrum and loss of bone substance.—The patient, a woman aged thirty-five, came for examination June 9, 1923, because of ununited fracture of the right forearm. She had been in an automobile accident in March and sustained multiple fractures of both arms, a compound fracture of the right radius, fracture of some of the ribs, and severe contusion of the back. She was taken to the hospital, evidently in a serious condition, having been completely unconscious for six days, and more or less so for two weeks. Evidently the treatment of the fractures had been secondary to that of the shock. However, all fractures had healed in good position, with the exception of the one of the right forearm. A sinus had formed and continued to drain pus, and the bone failed to unite.

A roentgenogram of the right forearm showed a double fracture of the lower third of the right radius, with a large loose fragment of bone (Fig. 278). There had also been a fracture in the lower third of the ulna, which had united in good position. There was a draining sinus in the lower third of the right forearm over the radius. There was a certain amount of limitation of movement in the fingers of the right hand, and a considerable degree of radial deflection of the hand. The diagnosis was nonunion of the lower third of the right radius, and osteomyelitis with sequestrum.

July 19, under general anesthesia, the sinus in the forearm was explored and the sequestrum, which consisted of the entire thickness of the radius and was about 12 cm. in length, was removed. It was lying in a bed of foul-

smelling pus. A roentgenogram some weeks later showed that there had been no attempt at regeneration in the bone, there being a defect about 6 cm. long. There was even more tendency to radial deflection than at the time of the first examination. A splint was therefore provided which tended to hold the hand in ulnar deflection. The patient was dismissed and told to come back after the sinus had been completely healed for seven or eight months.

Eight months later, and one and one-half years after the sequestrectomy, the sinus had healed. There was a defect in the radius of about 3 cm.; the fragments were rounded on the end and somewhat osteoporotic, and there



Fig. 278—Compound double fracture of the radius with sequestrum

was marked radial deflection with dislocation of the styloid process of the ulna (Fig. 279). Bone was transplanted from the flat internal surface of the right tibia. After exposure and *freshening of the radial ends*, the graft was applied as a massive graft and held in place by two beef-bone screws through each fragment. The graft was about 10 cm. in length. The lower 3 cm. of the ulna were excised and cut into two pieces, and placed beneath the graft between the radial ends, thus filling in the bony defect. The removal of the lower end of the ulna permitted the correction of the radial flexion deformity.

Roentgenograms, March 13, 1925, showed that the bone graft was firmly united and the union seemed clinically complete (Fig 280). The radial deflection was almost entirely overcome. The patient was dismissed, wearing a splint as a protection.



Fig 279—Same as Fig. 278, one and one-half years after removal of sequestrum.



Fig. 280—Massive bone graft held in place with beef-bone screws, removal of lower end of ulna; lower ulna placed between ends of radius.

Radial deflection is a serious disability and always occurs when there is destruction and loss of bone in the lower third of the radius. In this case the necessity to wait months after the disappearance of infection entailed a delay of a year and a half before any attempt could be made to remedy the nonunion or correct the deformity. The preference here was for a massive graft from the tibia rather than an inlay. Splints so devised as to throw the hand in ulnar deflection may prevent radial deflection to a certain extent, but cannot do so completely. I cannot remember ever seeing ulnar deflection sufficient to cause any complaint following removal of the lower end of the ulna for any cause.

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THE STUDY OF FRESH TISSUE AS AN AID TO CLINICAL DIAGNOSIS, TREATMENT, AND PROGNOSIS

WILLIAM C. MACCARTY

Those of the medical profession who have been in the habit of checking up their clinical diagnoses must have realized that there is a certain appreciable and important percentage of patients in whom a positive clinical diagnosis of organic disease, benign or malignant, is impossible. By this statement is meant that organic morbid anatomic conditions do not always produce signs and symptoms which allow them to be positively recognized with the usual clinical diagnostic methods (inspection, palpation, auscultation, percussion, roentgenography, and examination of the blood, stomach, and urine). Valuable as such diagnostic methods are, they are far from being invariably exact. This fact can be determined by checking clinical diagnoses with the actual morbid anatomic findings at operation, necropsy, or, as is sometimes the case, with the postdiagnostic history of the patient.

In a study of 16,000 preoperative diagnoses or surgical instructions made by clinicians of average or greater ability, 24.66 per cent were qualified by reservations, were merely regional, or were characterized by such modifying or qualifying terms as "explore," "remove for diagnosis," "curet for diagnosis," and "excise for diagnosis." This type of diagnosis is no reflection on the clinician's ability. On the contrary, it is a sign of clinical honesty, since it illustrates his realization and admission of the physical impossibility of making a detailed diagnosis in terms of morbid anatomy. It is evidence of his desire not to deceive himself; it is the beginning of a scientific, efficient attitude toward disease which will eventually place medicine on the same exact basis which characterizes applied science.

It is this group in which I am particularly interested, and I have it in mind in urging the application of expert knowledge of morbid anatomy to the actual handling of the conditions while the patient is still alive. Disease, be it organic or functional, has a structural basis which, in the light of modern physics, may be smaller than we are accustomed to see with unaided eyes. In general, as all visualization has increased in efficiency the more evident has become the structural basis of all function.

To come to the point immediately, the study of the microscopic structure of human tissues, and their component cells during life can be made, is being made, and must be made if we are to render the greatest possible service to the patient. The expert morbid anatomist who has had his training at necropsy with low-power lenses must either avail himself of the new opportunity which operative surgery has given or be willing to grant just and unbiased consideration to those that have done so. He must not think, because he has not learned new things from fresh tissues or cannot do it, that it is impossible. The study of living tissues, or tissues which are not fixed and embedded, is one thing, and the study of dead tissues with their postmortem changes distorted by changes coincident to fixation and embedding, is another. The one should not be utilized as a standard of criticism for the other. Each has its place in our medical activities.

Twenty-five years ago surgical exploration was uncommon and tissues were studied only in the fixed and embedded conditions. It is true that even the older pathologists, like Rokitsansky and Virchow, did study what they called fresh tissues, with and without frozen sections, but it was not until Wilson brought out his method of preparing fresh tissues that they were seriously studied with the definite object of using them for diagnostic purposes as a routine during operation. This method opened up a new field of study which has been developed and abundantly tested. Although it was primarily evolved for histologic purposes, it paved a way for the investigation of the minute structure of normal and malignant cells under high magnification.

At operation the problem is to distinguish a benign from a malignant condition; it is not a problem of terminology or nomenclature, but one of clinical behavior. The object is to clarify the immediate and remote prognosis for the purpose of therapy. The day is, or should be, past when we act on the old rule: "When in doubt perform a radical operation." If we are to have a rule let it be: When in doubt explore and have expert diagnosis of the fresh tissue. The fresh tissue method of enhancing clinical diagnosis and prognosis has been used as a routine in the Clinic on more than 150,000 surgical specimens removed at operation or exploration. In this series there were more than 40,000 neoplasms. In a recent series of 1,213 surgical patients, 16.4 per cent came to operation with doubtful diagnoses, or diagnoses which, although regional, were not positive so far as organ or malignancy was concerned. In this series 12.6 per cent required microscopic study. The pathologist was called into clinical consultation and 17.5 per cent of these consultations resulted in a change in the treatment and prognosis from that indicated by the clinical preoperative instructions. In 0.5 per cent of all surgical cases (including hernias and fractures) a malignant condition was found on routine study (during operation) where no malignant condition was suspected either clinically or surgically.

Can the morbid anatomic diagnosis be made grossly by the surgeon or pathologist? It has been said, "The frozen section immediately reveals the nature of many tumors, but usually only those which an experienced pathologist can recognize by gross examination. It thus tends to discourage the careful gross examination of the tumors. The five or six minutes consumed in making a frozen section may often better be spent in a more careful search and ocular inspection of a suspicious breast."

What constitutes an "experienced pathologist" might be open to discussion, but after an experience in pathology of twenty-four years, and with more than 150,000 surgical specimens during the last eighteen years, my own ability to diagnose gross material from all specimens from all sources is not more than 81.8 per cent. This figure was determined by actual test

in 47,434 surgical and diagnostic specimens. In other words, 18.2 per cent of all specimens from all sources require microscopic examination, in my own experience, before the diagnosis can be accurately made. This percentage varies in different portions of the body, in the breast it is from 6 to 10 per cent; in many other regions it is much higher, and in some much lower. One can hardly pick out suspicious areas without some ability in the diagnosis of gross specimens, which ability should become greater

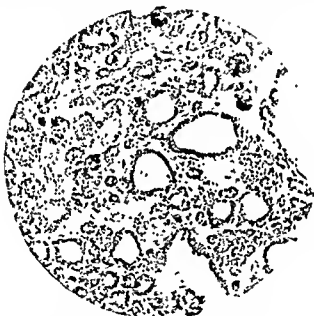


Fig. 281 — Photograph of a routine fresh unfixed frozen section of an adenoma of the thyroid

the more often it is checked by microscopic study. One can improve it only by becoming a good microscopic diagnostician; gross appearance is dependent on smaller things than can be seen by the unaided eye.

It must be remembered that the freezing microtome is not the important factor, the diagnosis depends on knowledge of cells and the tissues they form; it is dependent on structural pictures which actually exist and not on postmortem changes and

artifacts which have been our standards of judging disease. The cells can best be seen with oil lenses, without fixation. The microtome is merely a means of very rapidly preparing tissues for study. An expert can make a cellular diagnosis without a microtome. Whether the preparation by fresh freezing methods is capable of producing reliable pictures may be determined by comparing Figs. 281 to 284 (from routine slides) with those made by fixing and embedding methods. The proof of their value rests in the prognosis made from them and not in the diagnosis.

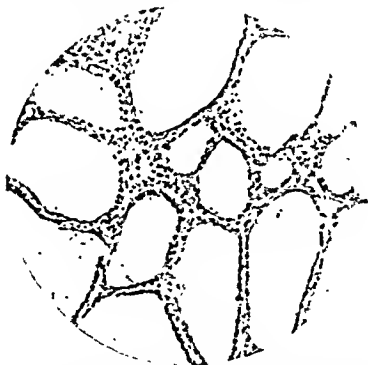


Fig. 282 —Photograph of a routine fresh unfixed section of a colloid goiter.

There are several special functions of the clinical pathologist which should be a part of operative surgery. Every gastric ulcer, regardless of clinical or gross pathologic diagnosis, should be studied as a routine for the presence of early carcinoma, in order to bring about resection instead of excision when technically possible, and in order to give a correct prognosis. All breasts containing a lump without the clinical signs and symptoms of cancer, and those showing a discharge from the

nipple, require wide excision of the mass or removal of the gland-bearing portion of the organ for immediate study, in order to



Fig 283 —Photograph with the oil lens of cells in Fig. 281

prevent the effects of incorrect clinical diagnosis and prognosis, to avoid too radical or insufficient surgical treatment or to avoid



Fig 284 —Oil emersion photograph of a malignant cell in cancer of the breast. This is perfectly fresh, unfixed, and unembedded. It is from a routine diagnostic section, made within two minutes after the removal of the tissue

a second operation. When a surgeon has a clinical pathologist associated with him who is well trained in the study of fresh

tissue, there is never any need for the complete removal of breasts unnecessarily nor for incomplete operations when radical treatment is technically possible.

Conservative surgeons know that they not infrequently meet tissues in all parts of the human body the exact nature of which they cannot recognize grossly. With them it is a question of whether to perform a limited operation or proceed with a radical one. Specimens, in such cases, may be removed; they may be studied, and should be studied immediately in order to help the surgeon proceed intelligently with all possible available knowledge.

The uterus presents its problems. It is very often impossible to differentiate malignant from other conditions, such as fibromyomas, polyps, placental remnants, adenomyomas, sclerosis, and para-uterine lesions which give similar signs and symptoms. Should the uterus be removed without a positive diagnosis? Were we to follow the old adage, "When in doubt perform a radical operation," many uteri and their appendages would be sacrificed unnecessarily. Moreover, there would be an operative mortality of from 1 to 5 per cent which is too great a burden to assume simply because some pathologists and surgeons are not willing to see the possibility of a newer method of diagnosis. The uterus can be curetted and the curettings studied in the perfectly fresh condition. In no instance in the Clinic has a uterus failed to show carcinoma after its removal, when it was advised on the fresh tissue diagnosis. Many of the lesions have been small; large, sloughing carcinomatous masses are rarely curetted in my experience. It is possible for the pathologist to fail to find the carcinoma because the curet may not always remove the carcinomatous tissue in small lesions.

The examinations of lymph-nodes in various parts of the body is frequently important. Primary lesions are sometimes not accessible or their exploration may be attended with great risk; a regional node may tell the story and give immediate valuable information to the operator. It may determine his operative procedure, his x-ray or radium treatment, and allow him to give a scientific prognosis to the patient or the relatives.

Aside from the aid given by the clinical pathologist, in determining the clinical diagnosis, his department may serve to pick up many unsuspected conditions in the routine examination of all specimens removed surgically. Thus, as has been stated, one out of every 200 surgical cases studied as a routine in this series showed a malignant condition which made considerable difference in the treatment and prognosis.

There is one other function valuable to the surgeon and hence to the patient. Resected specimens are sometimes not complete and the line of excision may be too near the malignant tissue. The surgeon does not always realize this fact since he naturally desires to conserve tissues. If he can be told of the condition he may be glad to extend his operation and enhance the prospect of cure.

These are but a few of the principles involved in the function of a study of fresh tissues in the practice of medicine. The clinical pathologist's duties do not cease there because, if he has studied the clinical side of his specialty, he is a help in all clinical consultations, since his experience in checking clinical diagnosis is the best teacher of clinical foresight.

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SURGICAL TREATMENT OF CHRONIC LESIONS OF THE BONE

HENRY W. MEYERDING

Case I. Spondylolisthesis of the fifth lumbar vertebra treated by an autogenous bone graft.—A man, aged forty-eight, came to the Clinic in December, 1924, complaining of backache of three years' duration. There was a definite history of trauma; the patient remembered having lifted a heavy object and straining his back, near the time of onset of the symptoms. The pain had been dull and aching, and limited to the lower lumbar region. For the last two years, the patient had been unable to do his usual heavy work because it always caused an exacerbation of his trouble. Although the pain was constant, there was comparatively little trouble if the patient confined himself to doing chores around the house, until the last few months when the symptoms gradually became worse and any type of exertion brought on severe attacks of backache. There was marked weakness and stiffness of the back during these attacks. A noteworthy feature in the history was that the pain did not radiate. The patient himself had noticed no deformity of the spine.

Physical examination revealed that the patient was in good general condition. Examination of the spine revealed prominence of the upper portion of the sacrum, a lumbar lordosis and a shortened torso. The trunk appeared to be telescoped into the pelvis. The rib margins impinged on the ilia. There was general restriction of motion in the spine. The patient walked bent slightly forward, and the gait could be characterized as "waddling." There was no evidence of caudal involvement. The roentgenographic examination of the lower spine, both in the lateral and anteroposterior views, showed a subluxation of the fifth lumbar vertebra on the sacrum. No associated congenital bony defects or variations were noted (Fig. 285).

On account of the great and increasing disability and suffering in the lower back, I decided to perform a bone-graft operation to stabilize the spine in this region. A curved graft was removed from the tibia with an electric saw and inserted into the split spinous processes from the first lumbar vertebra down to the second sacral segment. Following the insertion of the graft, the patient was put on a Bradford frame with support under the lumbar spine, the frame being raised and lowered by means of pulleys, ropes, and windlass to facilitate nursing and the use of the bed pan. When the patient is able to be up, I shall apply a plaster-of-Paris cast in the belief that this gives far greater support to a lesion in the upright position. The cast may be applied immediately after the operation, if desired. This support is to be

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There is one other function valuable to the surgeon and hence to the patient. Resected specimens are sometimes not complete and the line of excision may be too near the malignant tissue. The surgeon does not always realize this fact since he naturally desires to conserve tissues. If he can be told of the condition he may be glad to extend his operation and enhance the prospect of cure

These are but a few of the principles involved in the function of a study of fresh tissues in the practice of medicine. The clinical pathologist's duties do not cease there because, if he has studied the clinical side of his specialty, he is a help in all clinical consultations, since his experience in checking clinical diagnosis is the best teacher of clinical foresight.

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Examination revealed that his general health was good. His height was 5 feet, 6.75 inches, his weight 110 pounds, and his pulse and temperature were normal. The left leg was 2.25 inches shorter than the right, with atrophy of both thigh and calf and a slight compensatory scoliosis. Trendelenburg's sign was positive and the great trochanter was above Nélaton's line. There was marked limitation of abduction but increase in adduction. Both internal and external rotation was limited, and painful at the extreme limits of motion. The urine was normal, hemoglobin was 75 per cent; the erythrocytes numbered 4,100,000, the leukocytes 9,800, and the Wassermann reaction was negative.

A diagnosis was made of *coxa vara* of the congenital type, which appeared to be still slowly progressive. I suggested and carried out the following

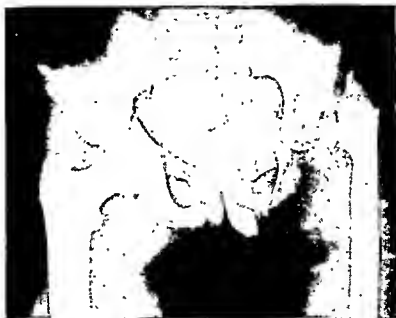


Fig. 286 —Congenital *coxa vara* before operation, marked deformity.

operation. The neck of the femur was exposed by a Smith-Petersen incision. The fissure in the neck was found to be filled with fibrous tissue, and separation of the two fragments was easily carried out at that point. The outer portion of the great trochanter with the attached muscles was separated upward, the outer portion of the neck attached to the intertrochanteric region was removed. The upper end of the diaphysis was freshened as well as the outer aspect of the head. These two surfaces were brought together with the leg in wide abduction, the adductors having been tenatomized, and the great trochanter was sutured at a lower level on the shaft of the femur. The incision was closed and a cast applied from the ribs to the toes on the affected side, and to just above the knee on the nonaffected side. Roentgenograms (Figs 286, 287) show the condition immediately before and after operation. The patient was recumbent for two months, then began bearing weight with

the cast on for two more months, after which he was dismissed much improved, with 1 inch of shortening. He was able to walk without a cane. Four months after operation he reported that he was greatly improved and walking.



Fig 287.—Postoperative result following a reconstruction operation for congenital coxa vara accompanied by increasing deformity and pain

This operation for congenital coxa vara suggested itself after my experience with the Brackett and Whitman operations for fracture of the hip. To my knowledge this is the first time it has been performed for this condition. It is recommended by its results and its correction of an otherwise increasing deformity.

Case III. *A type of fracture of the internal semilunar cartilage of the knee.*—A man, aged twenty-one, came to the Clinic January 30, 1925, complaining of locking in the right knee-joint, which was caused by his stepping into a hole six years before. There was swelling and pain which persisted sixteen weeks, and which the attending physician treated by massage and liniments. For three years he was free from attacks, and then, while running upstairs, he had a recurrence. Later, he learned that the locking could be reduced by tying one end of a rope to the leg and the other to a tree, and then pulling the leg. By this means, he was able to straighten the leg and relieve the symptoms.

Examination revealed slight tenderness, and apparently a slight fulness over the internal semilunar cartilage of the right knee. There was no limitation of movement and no pain at that time. The x-ray, Wassermann test, urinalysis, blood count, and general physical examination otherwise were negative. The patient estimated that he has had twenty distinct lockings in

six years. The symptoms were those of a fractured internal semilunar cartilage.

On February 5, after iodm preparation, a straight incision was made in the joint to the inner side of the patella just above the semilunar cartilage. On incising the synovia there was a gush of synovial fluid, and directly beneath the incision, the fractured semilunar cartilage was visible. When the knee was flexed, the cartilage could be demonstrated as torn off on the inner side and lying across the articular surface of the tibia in the manner known as the bucket handle type of fracture of the internal semilunar cartilage. The anterior attachment was cut off with a knife, and then with a knee inflexion and slight external rotation, was easily detached posteriorly.

The last three patients whom I have operated on for the removal of internal semilunar cartilage have shown this bucket-handle type of fracture of the cartilage, which is easily removed through a straight incision, 1 5 inches in length, to the inner side of the patella. In this type of fractured cartilage the patient may be assured of relief from symptoms. After this small incision the patient is able to return to his occupation in a minimal length of time, and trauma is avoided. A posterior splint may be used for two or three days, after which a firm bandage and dressing are sufficient.

Case IV. Chondroma in the lower end of the femur.—A woman, aged fifty-three, was examined in August, 1916. The patient complained of nervous indigestion, insomnia, rheumatism, and lameness of the left knee. Lameness and stiffness had been present for seven years, although there was no limitation of motion, no deformity, nor tenderness. A diagnosis of sarcoma had been made elsewhere, and amputation had been advised. No definite enlargement of the knee nor limitation of motion was found. The urinalysis was negative, the hemoglobin was 80 per cent, the leukocytes, 5,200. The tonsils were enlarged and contained septic material. The x-ray showed the presence of a tumor in the lower end of the left femur. Other x-ray findings were negative. August 18, 1916, the tumor was explored and curetted, and found to be a chondroma. Radium was used. April 5, 1917, the wound was curetted and the cavity filled with fat from the abdominal wall. The patient continued to walk after her operation in 1916, until she had the misfortune of sustaining a fracture of the hip in an accident in 1924, at which time roentgenograms of the fractured hip and tumor were taken (Fig. 288). There was no evidence of a pathologic condition in the neck of the femur at the time of the fracture.

These chondromas may present such a complex picture that the clinical and roentgenologic examinations make it necessary

to operate and examine microscopically the specimen in order to make a correct diagnosis. Chondromas may recur following careful curettage, and one should be careful to observe that the tumor is not malignant. These tumors also occur in the multiple form and are considered malignant in the sense that they may cause death. In the cases I have observed in which a diagnosis was made of chondroma, subsequent findings have failed to show malignancy. Degenerative processes may produce cysts due to



Fig. 288—Chondroma of the femur, roentgenogram taken in 1924, eight years after operation. There is little change in the x-ray appearance of the femur during that time.

pressure and poor vascular supply. The x-ray is of great value in determining the size, location, and the difference between the single and multiple varieties of chondroma, but it should not be depended on in making a definite diagnosis. There is some similarity in roentgenograms of giant-cell tumors and chondromas. Surgery should be conservative. With complete removal of the tumor, the prognosis is favorable.

Case V. Fracture of the humerus with anterior dislocation—A coal miner, aged thirty-three, came to the Clinic October 4, 1924, complaining of pain and dislocation of the left shoulder, with fracture of the humerus. He stated that on August 3, he had been struck by an automobile and crushed

underneath it. He was unconscious for a short time. A wound in the left shoulder was sutured and an attempt made to reduce the fracture dislocation under anesthesia without success. For the last two months he had carried the painful left arm in a sling, being unable to obtain function in the shoulder.

On examination there was evident deformity of the left shoulder, and palpation disclosed the head lying anteriorly in the axillary space. There was false motion at the site of fracture, 3 inches below the head. The x-ray demonstrated fragmentation of the upper left humerus, with a subcoracoid dislocation of the head (Fig. 289). Although two months had elapsed since the injury, there was no evidence of damage to the brachial plexus. However, the patient was incapacitated, the prognosis as to function was unfavorable, and he was in pain.



Fig. 289 —Subcoracoid dislocation with comminuted fracture, of two months' duration, at the neck of the humerus.

The difficulties of operation and the prognosis were explained to the patient; operation seemed the only chance of obtaining a result. On October 8, an anterior incision was made, the head was exposed and found lying in the axillary space. There was a comminuted fracture of the upper end of the humerus with delayed union. The head of the humerus and a large triangular fragment of the humerus were dissected free. The glenoid cavity was filled with fibrous tissue, which was cleared so that the head of the humerus could be replaced. A Parham band was placed about the site of nonunion. When this was completed, there was considerable improvement in motion in the shoulder. The patient's convalescence was satisfactory until the seventh day, when, on removal of sutures, considerable bloody fluid drained. There was a serous drainage until December 24 when the Parham band was re-

moved. There was at no time a frank infection. . . .
 a curettage was performed Jan
 without pain, discomfort, or t
 shoulder (May, 1925)

This case is of interest because of the fracture and dislocation of the shoulder, combined with delayed union, and the lack of brachial plexus involvement after two months. It is too early to decide as to the ultimate result, the patient still being under observation, but apparently there is union. We will look forward to restriction of motion which will gradually be lessened. Should drainage continue and the upper fragment sequestrate, excision will be performed. It was thought best, however, to attempt to reduce the parts to their normal anatomic condition as nearly as possible, and to determine what could be obtained through surgery, rather than to exise the head, or leave this otherwise young and able-bodied man with a deformity and disability.

Case VI. Nonunion of femur in child, treated by homogeneous bone graft and Parham bands.—A farmer's son, aged six, was brought to the Clinic January 2, 1924, because of nonunion of the right femur. Three years before, the child had sustained a fracture of the right femur in the middle third. He was taken immediately to a hospital where the leg was x-rayed, the fracture was reduced and put in a plaster-of-Paris cast and Buck's extension combined. A second roentgenogram was made a week later, which revealed malposition of the fragments. Therefore, an open reduction was performed and the leg again put in a cast for two months. A third roentgenogram made at the end of two months, revealed persistent malposition, a second operation was performed, and a cast again applied. The patient wore casts and used crutches for a year. In September, 1922, after further consultation, a bone graft operation was performed. The child wore a cast thirteen months, then a walking caliper splint. The nonunion still persisted, with shortening, deformity, and disability.

The child was then brought by his parents to the Mayo Clinic for an operation. Examination revealed that the boy was thin and undernourished, and weighed 43 pounds. There was nonunion in the middle third of the right femur. The right leg was underdeveloped; it was 51 cm. long, and the left 58 cm. There was atrophy of the thigh and calf. The tonsils were enlarged and there was a cervical adenitis, and a secondary scoliosis due to shortening of the right leg. Urinalysis was practically negative. The hemoglobin was 73 per cent, the erythrocyte and leukocyte counts were normal. The Wassermann reaction was negative, the von Pirquet reaction was positive. x-Ray examination revealed an ununited fracture of the middle third of the

right femur with marked over-riding (Fig 290) x-Ray examination of the chest was negative. The child's general condition was unsatisfactory, and he was sent home with a walking caliper splint, and directions to be put on a nutritious diet and be given cod-liver oil for several months.

July 24, the patient returned. His general condition was improved. There was still nonunion of the right femur and marked osteoporosis. Urinalysis was negative. The hemoglobin was 71 per cent. Operation was performed August 26. A homogeneous graft being the most satisfactory one available, it was taken from the mother's tibia and inserted into the child's



Fig 290—Roentgenogram of ununited fracture of three years' duration, in a child of six years. A second fracture which has united is seen in the lower third of the femur.

femur. This graft was held in position by two Parham bands (Fig. 291). It was applied with the leg in extension so that an increase of 0.5 inch in length was obtained. Numerous small spicules of bone, together with an osteoperiosteal graft, were inserted about the site of nonunion. A long double spica cast, extending to the toes on the right and to the knee on the left, was applied. On October 3, the stitches were removed and the cast changed. The patient was dismissed October 15, and advised to return in four months. He returned March 9, 1925, the cast and Parham bands were removed. Firm bony union was present.

The use of foreign material is not routine with us in the fixation of bone grafts; the use of Parham bands, however, was necessary because of the extreme osteoporosis and difficulty of holding the atrophied and weakened extremity. The child's



Fig. 291.—Ununited fracture reduced, and homogeneous and osteoperiosteal grafts held firmly in position by two Parham bands

bone was hardly suitable to use in grafting, and his physical condition contraindicated undue surgical shock.

Case VII. Benign foreign-body giant-cell tumor of the femur, treated surgically and by radium.—The patient, a boy aged eighteen, came to the Clinic in October, 1922, complaining of pain in the left hip. Five months previously, he had begun to complain of pain and tenderness in the left hip, which steadily became more severe and finally prevented sleep. The pain recently radiated down toward the knee. He had had medical treatment. During this time he lost 12 pounds. The patient's home surgeon considered that it was probably sarcoma, and sent the roentgenograms to a consultant who called it "a mild bone tumor."

Examination revealed slight swelling and tenderness in the region of the great trochanter of the left femur. The pulse, temperature, and blood pressure

were normal. The urine showed a trace of albumin. Hemoglobin was 79 per cent; the leukocytes numbered 7,300, and the Wassermann reaction was negative. From a roentgenogram of the left femur a report was made of osteomyelitis with marked periosteal overgrowth. In my opinion, it was a subperiosteal ossifying hematoma. As the question of sarcoma had been raised, and as there was a difference of opinion, exploration was advised, treatment to be based on the findings.

At operation, on chiseling through the raised bony prominence, I found a cavity filled with amber-colored fluid and a grayish-looking tissue. I



Fig. 292.—Cystic area in cortex of the femur which was curetted; it later recurred. Pathologist reported giant-cell tumor.

therefore concluded that this was an old ossifying hematoma, and after chiseling off the outer cortex of the cystic area (Fig. 292) closed the wound without drainage. The pathologic report from the material removed was benign giant-cell tumor.

The patient was dismissed on the fourteenth day, with the wound healed, and apparently in good health. He was asked to report in three months for further observation. He returned nine months later, complaining of pain in the region of the operative field. His local doctors had again told him that his condition was due to sarcoma. The x-ray revealed nothing unusual, merely the postoperative changes which one would expect. However, be-

cause of the patient's fear of sarcoma, and the return of symptoms, a second exploration was made. A cavity covered by a layer of bone, 0.125 inch thick, was disclosed, containing tissue resembling granulation tissue. After curettage there was considerable hemorrhage from six distinct spurting vessels. The wound was packed with iodoform gauze. The pathologic report on the specimen removed was hemorrhagic osteomyelitis accompanied by new bone formation and foreign-body giant-cells.

In view of the recurrence and the vascular type of the tissue removed, it was thought advisable to employ radiotherapy, and the patient was referred for such treatment. He was dismissed a month after the operation, apparently in good condition. March 8, 1923, the father wrote that his son was going to school, had gained in weight, and had had no further trouble.

This case illustrates an unusually interesting benign bone lesion which was probably of inflammatory or traumatic origin, and which had been diagnosed as malignant. The cystic area containing fluid, found at the first operation, might have resulted from a subperiosteal ossifying hematoma. The grayish tissue removed when examined microscopically revealed a benign giant-cell tumor. The recurrence of this lesion with bone proliferation and marked vascularity indicated radiotherapy. This case illustrates the value of exploration and microscopic examination before causing the patient undue worry by making a diagnosis of malignancy from the x-ray and clinical findings alone. In previous communications on bone tumors I have emphasized the value of exploration and microscopic examination of tissue in certain cases. Benign and malignant bone tumors cannot always be positively differentiated from the x-ray or clinical examination alone.

PLASTIC SURGERY OF THE NOSE

GORDON B. NEW

Case I. Saddle-back nasal deformity: Cartilage implant.—A man, aged twenty-eight, a miner, came to the Clinic because of a saddle-back nasal deformity, of fifteen years' duration, due to injury by a baseball. An



Fig 293 —Traumatic saddle-back nasal deformity.



Fig 294 —Photograph after operation on deformity (Fig. 293). The deformity was corrected by insertion of rib cartilage. Note the incision just below the tip of the nose.

unsuccessful attempt had been made six years before to build up the nose. His general health was excellent and he had no other complaints. The nasal deformity was typical of the traumatic type of deformity with the flaring of the nasal bones and nasal process of the superior maxillary bone (Fig. 293).

September 23, 1923, the first operation was performed. An incision was made inside the nose in the lateral wall of either nostril. By means of curved scissors the skin over the entire bony part of the nose was elevated, and then, with specially prepared rasps, the lateral bony deformity was

rasped off. December 2, 1924, a second operation was performed. A lead model of the lost tissue had been made. The entire thickness of the cartilage of the right seventh rib was removed under ether anesthesia, and was then trimmed to conform to the lead model. A small incision was made below the tip of the nose and the skin elevated from this point to the glabella, care being taken to reach the bone. The cartilage was inserted through this incision, and the wound closed with dermal sutures. Small rolls of gauze were applied on either side of the nose and held in place with adhesive plaster. The patient's convalescence was uneventful and the result was as shown in Fig. 294.

Saddle back nasal deformities are best taken care of by means of a lateral deformity should be rasped on the cartilage, or the lateral deformity with skin on the nose. Although the cartilage is frequently inserted through an incision across the bridge of the nose, the cosmetic result is better if it is inserted through an incision below the tip. Thus far no infections have followed this method and the results have been very satisfactory. Local anesthesia is generally induced.

Case II. Nasal hump; removal.—A man, aged twenty-nine, came for examination October 1, 1924, on account of a traumatic nasal deformity. When three years old he fell and struck his nose, but received no treatment at that time. Two weeks before coming to the Clinic he was struck on the side of the nose with a croquet mallet. The nasal hump had been present for many years (Fig. 295).

Examination showed a marked hump of the nasal bones extending from the tip of an inch of the tip of the nose. There was apparently the result of a recent injury, right side from a deflected septum. The general examination was normal.

October 4, 1924, a submucous resection of the nasal septum was performed in the Section on Otolaryngology. October 13, under local anesthesia, I made an incision across the bridge of the nose and removed the nasal hump by means of a saw and bone forceps. The convalescence was uneventful (Fig. 296).

Humps over the nasal bones and the nasal processes of the superior maxilla are usually removed through an incision inside the lateral wall of the nose. Small dissecting scissors are carried up onto the nasal bones, and the skin over the entire bony structure of the nose is elevated. The hump is rasped off by

rasps that cut with a pulling movement. The larger ones are better taken care of with saws or bone forceps. In order to prevent a hematoma it is essential that pressure be applied over the bridge of the nose. Various types of splints are used for the purpose, but gauze with adhesive plaster is usually quite satis-



Fig. 295.—Bony hump on the nose before operation.



Fig. 296.—Photograph after removal of hump (Fig. 295) by means of a saw and rasps through an incision across the bridge of the nose.

factory. In twelve hours the skin over the bridge of the nose should be exposed to make sure there is not enough pressure to cause a slough.

Case III. Traumatic nasal deformity; refracture.—A man, aged nineteen, came for examination July 15, 1924, on account of a traumatic nasal deformity of two months' duration. He had been accidentally struck by a baseball. His physician re-set the nose but, even in spite of the treatment, it shifted over to the left and became much flattened. There was marked nasal obstruction.

Examination disclosed a traumatic deformity of the nose, with marked depression of the right nasal bone and displacement of the left nasal bone and the nasal process of the superior maxillary bone to the left (Fig. 297). The patient was advised to wait six months from the time of the injury before

having an attempt made to correct the external deformity. General examination was negative.

November 3, a submucous resection was done in the Section on Otolaryngology to correct the nasal obstruction, and December 16, under local anesthesia, through an incision just inside the ala of the nose, on either side, I elevated the skin over the entire bony framework of the nose and with forceps fractured the nasal bones and the nasal process of the superior maxillary bone, carried them into correct position and held them there by means of gauze and adhesive plaster. Figure 298 shows the postoperative result of



Fig. 297 —Traumatic nasal deformity in which the nasal bones and nasal processes of the superior maxilla are displaced to the left



Fig. 298 —Photograph after operation on deformity (Fig 297). The nasal bones and nasal processes of the superior maxilla have been replaced under local anesthesia, through incisions inside the nose.

the refracturing. The patient will probably require a cartilage implant to elevate the slight saddle-back deformity.

Nasal deformities which require refracturing were formerly cared for under general anesthesia. A piece of gauze was applied over the most prominent part of the nose and struck with a mallet to refracture the nasal bone. Such patients are now treated under local anesthesia. An incision is made inside the nose, as outlined, the skin is freed from the bony structure,

and then by means of forceps the nasal bones and the nasal process of the superior maxillary bones are refractured and placed in correct alinement. On the concave side of the nose this is done by rotating the upper part of the fragment outward, while on the convex side the upper part of the fragment is rotated inward. Pressure is applied by means of small rolls of gauze held in place by adhesive plaster.

Case IV. Harelip nasal deformity; cartilage implant.—A woman, aged nineteen, came to the Clinic April 29, 1924, on account of a postoperative harelip and cleft-palate. The lip had been repaired at the age of three months. Later the palate was repaired by the home physician.



Fig. 299.—Postoperative harelip deformity. Note the flattening and lengthening of the tip of the left side of the nose and the notch in the vermillion margin of the lip

Examination revealed a notch in the vermillion margin of the lip with the usual flaring nostril, rotation of the tip of the nose and the flattening of its left side (Fig. 299). The hard palate was open, the soft palate partially closed, both showing a great deal of scarring. May 5, the lip was repaired by excision of the scar and readjustment of the ala and vermillion margin. May 14, the projection of the left tip of the nose was excised and a saucer-shaped cartilage implant taken from the back of the left ear was inserted through the same incision (Figs 300, 301).

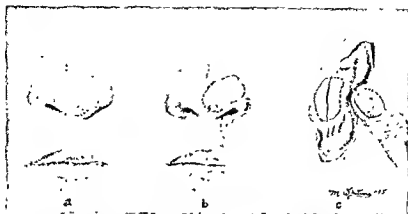


Fig. 300 —(Shown in Fig. 299) (a) A dotted line across the part of the left tip of the nose that was removed, (b) position of the saucer-shaped piece of cartilage inserted to elevate the flattening of the left side of the nose through an incision in the lower margin of the ala, and (c) the location from which the cartilage was obtained



Fig. 301 —Postoperative photograph of patient shown in Figs. 299 and 300, five months after operation

It is difficult to correct harelip nasal deformities in adults. After bringing the ala to its correct position, there is always

some flattening of the side of the nose, and the tip on the same side is usually elongated. This may be corrected, as in this case, by trimming off the lower portion of the tip and inserting a saucer-shaped piece of cartilage from the back of the ear to elevate the part. If necessary, the cartilage may be obtained from the rib, leaving the perichondrium on one side and inserting it so that the periosteum is left on the concave side to give the natural contour to the nose.

Case V. Loss of lower portion of the nose from lupus and plaster: Flap from forehead lined with full thickness graft.—A woman, aged twenty-nine,



Fig 302—Destruction of the right side of the nose, and a portion of the tip from lupus and plaster



Fig 303—Photograph of patient shown in Fig 302 after operation. A delayed flap from the forehead lined with a full thickness skin graft has reconstructed the nose. The vestibule is open, owing to the use of the full thickness skin graft

came to the Clinic October 23, 1923, for reconstruction of the nose, which had been destroyed by lupus and plaster. The lupus had started three years before, and various types of treatment had been given, including x-ray. She obtained a plaster from a peddler and applied it herself. This caused most of the deformity (Fig 302). The patient was well otherwise.

October 29, a pedicle flap with the pedicle just to the right of the median

line of the forehead, and the flap extending up to the left forehead, was outlined and elevated, under local anesthesia, and a full thickness graft inserted underneath the distal end, raw surface to raw surface, and held there under pressure. About two weeks later, the full thickness graft having grown firmly to the flap, the whole was elevated, but still left attached by the pedicle. Three days later, it was brought down in place over the nose, and after the margins had been freshened it was sutured in place over what was left of the columella, and attached laterally to what remained of the alae. Thus the skin of the flap formed the external surface, and the skin of the graft the internal surface of the nostril. December 10, 1923, after cutting off the pedicle, the proximal end of the flap was sutured back in place on the forehead, and the free portion of the flap sutured in place over the nose. The patient was then allowed to go home for three months as the nose appeared quite large. She returned March 8, 1924, and the superfluous part of the flap was trimmed down in three stages, to improve the appearance. Figure 303 shows the patient April 4, 1924, shortly after removal of the sutures. It demonstrates how the use of the full thickness graft underneath the distal end of the flap has maintained a good right nostril.

By far the most satisfactory place to secure a pedicle flap for reconstruction of part of the nose is from the forehead. Taking the flap from the cheek causes unnecessary scarring and the color of the flap from the neck is not as satisfactory as that of the forehead. In order to obtain an open nostril in these cases, the use of full thickness grafts underneath the distal end of the flap is very essential. They are more satisfactory than the Thiersch grafts for this purpose. It is best to delay the final shaping of the nose for at least three to six months after the flap has been sutured to the nose, on account of the shrinkage that takes place.

CARCINOMA OF THE CECUM AND ASCENDING COLON

WALTER E. SISTRUNK

This patient, a man aged fifty-six, complained of intestinal trouble. Five years before, appendectomy had been performed for perforated appendix. Four months later he had a slight fall, after which he noticed a small painless lump in the lower right abdomen, which gradually became larger. One year before, he began to have occasional dull pains of short duration in the lower midabdomen, and one month before he had had a quite sudden attack of severe pains in the same area which lasted twelve hours and subsided quite suddenly. He had had four such attacks. Slight nausea accompanied each attack and little or no gas was passed. At times he passed blood by rectum which he thought came from piles.

On examination a hard, but movable, slightly irregular mass was found in the right lower quadrant. The temperature and pulse were about normal. x-Ray examination of the colon showed a filling defect in the ascending colon. The diagnosis was probable carcinoma of the ascending colon.

After three days' preparation, during which the patient was given a small dose of castor oil and afterward was allowed to take only fruit juices, sugars, water and tea by mouth, an abdominal exploration was made through a right rectus incision. A large, movable, highly inflamed carcinoma of the cecum and ascending colon, was found which was producing partial obstruction. On account of the obstruction and the inflammation present in the growth, resection was not attempted. An ileocolostomy was made between the lower ileum at a point about 20 or 25 cm. above the ileocecal valve and the transverse colon near its middle. The ileum was then cut at a point between that at which the ileocolostomy had been made and the ileocecal valve, and each of the ends was closed and dropped back into the abdominal cavity. Following the operation the patient was kept for four days on subcutaneous injections of salt solution and was allowed nothing by mouth or rectum. During this time morphin sulphate was given in $\frac{1}{4}$ -grain doses every four hours for thirty-six hours, and afterward codein sulphate in $\frac{1}{4}$ -grain doses. Water in small amounts was then allowed by mouth and the day following, fruit juices, tea, and so forth. He did nicely following the operation, and three weeks later was again explored through the same incision and the right half of the colon was resected. The postoperative treatment was the same as after the first operation. The patient did nicely and is now ready to have heavy x-ray exposures over the area from which the growth was removed. He will be given three series of such treatments at intervals of about five or six weeks.

Carcinoma of the cecum and ascending colon is common. Statistics show that the stomach is probably more often the seat of carcinoma than any other portion of the digestive tract. Primary carcinoma is extremely rare in the duodenum and is infrequent in the small intestine, in the cecum it again becomes common and the incidence increases with the downward course of the colon, probably being greatest in the sigmoid and recto-sigmoid.

The early clinical symptoms of cancer of the cecum are intermittent pain associated with gaseous distention and increasing constipation. Often the pain is crampy in character, lasts for a short time, and, as a rule, is relieved by a satisfactory evacuation of the bowels or by the passage of gas. It may also be relieved by the sudden change in the location of gases which have accumulated in the intestines. Blood and mucus may appear in the stools early in the course of the disease, and often there are alternating attacks of diarrhea and constipation. A severe anemia often occurs early in cases of carcinoma of the cecum and ascending colon. In the later stages of the disease patients become very cachectic. At times complete obstruction develops.

Modern methods of diagnosis by the aid of the x-ray have greatly increased the number of cases in which an early diagnosis can be made. It is now often possible to make quite a definite diagnosis of malignant disease while the clinical symptoms are still vague.

Because of the virulence of the organisms in the contents of the lower intestinal tract, and because in many cases in which operation is performed there is either partial or complete obstruction, the removal of cancers of the ascending colon is often followed by fatal results. The virulence of the infection in the bowel wall surrounding the growth probably contributes to the production of the high mortality associated with this type of case. The thinness of the walls of the colon and its limited blood supply make healing less rapid than in other portions of the intestinal tract, and when there is gaseous distention before safe healing has taken place, leakage may easily occur along the suture lines and result in fatal peritonitis. On the other hand,

patients who survive operations for malignant disease of the ascending colon which is not too extensive, have an excellent chance to remain well, as it is often possible by a wide resection to remove not only the growth but also the glands draining the affected bowel. The end-results following operation depend very largely, however, on the extent of the disease at the time of the operation and, as in cases of carcinoma in other regions, are much less satisfactory when the glands are involved at the time of the operation.

The operability, in a given case in which no distant metastatic lesions can be demonstrated, depends largely on the ability and experience of the surgeon and the amount of risk he is willing to assume. Certain growths, which through inflammatory changes have become fixed to the surrounding structures, are operated on with difficulty, and in such cases operation should be attempted only by surgeons who have had considerable experience with this type of case. The mortality decreases and the percentage of operable cases increases with the surgeon's experience in dealing with the condition.

The operative mortality may be reduced by carefully preparing patients for the operation, by performing the operation in stages if there is obstruction, and by careful treatment after the operation. The degree of apparent obstruction should be carefully considered, as the preoperative preparation varies accordingly.

Patients without obstruction are probably best prepared by giving a purgative like castor oil about three days before the day set for the operation and an enema each night afterward. After the purgative has been given the patient should be kept on liquids, such as water, tea, ginger ale, lemonade, orangeade, chocolate, and sugar; all proteins should be withheld. For twenty-four hours before the operation a teaspoonful of paregoric should be given every four hours to diminish the intestinal juices and to produce constipation. When patients are prepared in this manner, the intestines are usually found to contain at the most small amounts of solid fecal material and the operation may be performed with a minimal amount of soiling from fecal

material. The complete change to a small carbohydrate diet and liquids before the operation also tends to change the intestinal bacteria.

Patients who show evidences of partial obstruction should not be purged on account of the danger of precipitating an acute obstruction. The preparation in such cases usually consists of an ounce of mineral oil three times a day and enemas night and morning for four or five days before the operation. Otherwise the preoperative management is the same as when no obstruction is present.

If acute obstruction is present nothing is to be gained by preoperative preparation, and early operation for the relief of the obstruction offers the patient the best chance. Radical operations, in the face of acute obstruction, result in a very high mortality and should never be performed. In such cases the bowels are usually filled with liquid material which teems with virulent organisms, and it is almost impossible to operate without considerable soiling. The infection and edema of the bowel wall, for a considerable distance beyond the growth, tend to prevent satisfactory healing. Operation under such circumstances is usually followed by fatal peritonitis. A considerable difference is noted in the mortality following radical operations in nonobstructed and even partially obstructed cases, and for this reason a preliminary operation or the relief of even partial obstruction should always be performed, if possible, before radical resection is attempted.

The handling of highly infected growths and trauma to the surrounding tissues in such cases also greatly increase the operative risk.

The type of operation selected in dealing with cancer of the ascending colon should depend on the amount of obstruction and infection present. Occasionally carcinomas occur without obstruction and with only slight adjacent inflammatory reaction. Nothing is to be gained by the two-stage operation in such cases, and a radical resection, with an enterostomy at the same time to relieve the gaseous distention after the operation may be performed. When obstruction or marked infection is present

in the growth a short-circuiting operation, such as an ileocolostomy to the transverse colon, should be performed first, to relieve the obstruction. In such cases the ileum between the point where the ileocolostomy has been made and the ileocecal valve is usually cut and both ends closed, in order to take away the fecal material from the ascending colon, and place the portion of the bowel containing the tumor at rest. After about two weeks the inflammation surrounding the growth will often largely subside; in many cases the growth will present a very different appearance when the second operation for resection

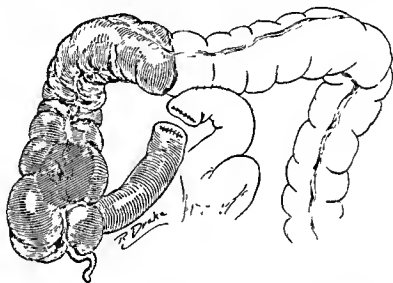


Fig 304.—Operation preparatory to resection of the ascending colon for cancer; ileocolostomy Shaded portion of bowel to be resected later.

is performed, and the radical resection may be then performed with much greater safety (Figs. 304, 305).

The postoperative care should be directed toward the prevention of peristalsis and gaseous distention long enough after the operation to allow satisfactory healing. This is best accomplished by withholding fluids by mouth or rectum for a period of from four to six days. During this time patients are given sodium chlorid solution subcutaneously in amounts from 2,000 to 2,500 c.c a day. During the first thirty-six hours morphin in 1/6-grain doses is administered every four hours, and then,

because some patients became quite irrational under the further use of morphin, codein in $\frac{1}{2}$ -grain doses is substituted and continued for one or two days longer. The length of this treatment depends largely on the postoperative reaction. If the temperature and pulse remain about normal, the patients are usually allowed to take water by mouth after four days, and the subcutaneous injections are discontinued. Water alone is continued by mouth for a day, and fruit juices and sugars are then added. If a sharp postoperative reaction occurs, the pulse is the best



Fig. 305—Ileocolostomy after the second stage of the operation has been performed and the ascending colon removed.

index as to when fluids should be allowed by mouth, and when the pulse drops and remains down, usually about the fourth, fifth, or sixth day, water is given by mouth and the subcutaneous injections are discontinued.

Under such treatment patients remain remarkably free from pain and gaseous distention. Its only disadvantage is the accompanying thirst and the discomfort associated with the subcutaneous injections. Thirst is not relieved by fluids given

subcutaneously, even in large amounts, but only by stimulating the salivary glands. Without much stimulation parotitis may develop. The thirst is most satisfactorily relieved and the salivary glands best stimulated by frequently rinsing the mouth with water, orange juice, or salt solution, and by allowing the patient to occasionally bite a piece of lemon. The prevention of peristalsis and gaseous distention, which is so satisfactorily accomplished by this type of treatment, is of the utmost importance in obtaining the greatest immediate postoperative safety.

When patients have gained sufficient strength to permit the use of the x-ray, a series of exposures are usually given over the site of the operation and over the glands draining this area.

SACROCCOCCYGEAL SINUSES AND CYSTS

JAMES C. MASSON

During the last five years eighty-one patients have come to the Clinic because of congenital sinuses or cysts in the sacro-coccygeal region. In 1912, Giffin and Archibald reported thirty-one cases treated in the Clinic previous to that time. Sacro-coccygeal depressions or dimples have not been noted, but according to other observers they may be found in about 25 per cent of cases if looked for. These conditions must be distinguished from perirectal and ischiorectal sinuses, many of which are tuberculous in origin, as well as fistulas of the anus, osteomyelitis of the sacrum or coccyx, spina bifida, teratomas, fetal implantations, traumatic dermoids, or implantation cysts (the results of penetrating injuries), fistulas originating from diverticulitis of the rectum, and a rare tumor composed of small epithelial lined cysts containing cholesterol and broth-like fluid.

The opening of a sacroccoccygeal sinus is, as a rule, in the median line between the tip of the coccyx and the anal canal, and runs upward toward the lower end of the sacrum or coccyx. In cases in which the opening is not in the median line, there is generally a well-marked depression at this point, and the existing sinus or sinuses are the result of previous operations or secondary infection in the cyst. In many such cases there are multiple openings instead of a tubular sinus. These openings communicate with a cyst-like cavity which may be of large size, as in the case reported here.

These cysts and sinuses are the result of abnormal processes during an early stage of development, and in the majority of cases only one embryonal structure is involved. In some of the more complicated dermoids and teratomas, however, there is more than one layer of blastoderm, and as Ewing says, "The

entire group is not only numerous but complex, and a rigid classification is at present impossible . . . The embryonal structures which give rise to these growths are chiefly: (1) The fovea coccygea and the coccygeal vestiges of the neural canal, (2) the neuro-enteric canal, (3) the postanal gut, and (4) the proctodeal membrane "

According to Bland-Sutton postanal dimples and coccygeal sinuses are the result of "faulty coalescence of the cutaneous covering of the back. . . Such recesses are lined with pilose skin that contains sebaceous and sweat-glands, and if the external opening becomes occluded without the deeper parts becoming obliterated, we would have the germ of a dermoid " Mallory, on the other hand, considers that most sinuses, as well as the tumors in the sacrococcygeal region, develop from remnants of the medullary canal in the *filum terminale* which failed to obliterate, the larger of which contained sebaceous and sweat-glands He was able to show by serial sections of this region, in several fetuses from three to six months old, canals lined with epithelium, some of which were connected with the skin He refers to a case in which J C Warren performed a secondary operation and found the sinus lined with pavement epithelium without gland or hair follicles

Incomplete obliteration of the neuro-enteric canal and postanal canal doubtless accounts for some of the cysts in the sacrococcygeal region Giffin and Archibald believe that such cysts rarely have openings on the surface of the body

I have had no experience with sacrococcygeal dermoids or sinuses that were not complicated by infection. In some of the cases there had been no external fistula until operation was performed In most cases examination afforded little information with regard to the origin of the sac, as the walls had been seriously destroyed by infection. Trauma is considered an important etiologic factor, and while injury or irritation may precipitate symptoms, it would seem that the inclusion of epithelial cells is the more important consideration.

Dermoids that are not attached to the skin and are not drained may grow to a large size without becoming infected or

causing any symptoms, but if once infected, will remain so and cause considerable trouble, especially if the external opening is small.

If the sac is obstructed by hair or sebaceous matter, it will soon become distended with purulent material mixed with the normal secretions, and unless lanced will rupture spontaneously. The same is true of the more common sinuses; occasionally multiple openings will result from long-continued suppuration. It has been suggested that the hair found in these sinuses comes from the outside. This may be true in certain cases, but in the majority it undoubtedly originates within the sinus or cyst, and is frequently a different color from the hair on the rest of the body.

Complete removal of the sac is the most satisfactory treatment. Incision and drainage, curettage, or the use of caustics is not satisfactory, but if the cyst or sinus is thoroughly dissected out, a permanent cure with a minimal period of morbidity is obtained. Complete removal is frequently facilitated by a thorough injection of methylene-blue before the operation is started.

Sixty-six of the eighty-one patients in the series were males and fifteen were females. The oldest patient to be operated on for a postanal dermoid was fifty-seven; the youngest was nineteen months, and the next youngest, sixteen years. The average age was thirty and ninety-five hundredths years. The majority of these sinuses are probably present from birth, but give little or no trouble until adult life is reached. Sixty-nine of the eighty-one patients complained of a discharging sinus, and twenty-nine, of periodic attacks of pain also. Fifty-six patients had single sinuses, the remaining twenty-five had multiple openings. Most of the patients believed trauma to be the probable cause of the condition.

Hair was found in only twenty-nine cases. In ten there was a history of hair being found at a previous operation, or in the discharge. There is no doubt that long-continued suppuration in many cases destroys the hair follicles.

Postanal dermoid.—A woman, aged twenty-six, came to the Clinic December 21, 1923, with a discharging sinus in the coccyg-

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anus, was an old scar with two sinuses containing a thick foul-smelling discharge. The hemoglobin was 71 per cent. The leukocytes numbered 6,503. Urinalysis revealed the specific gravity to be 1.030, albumin 1, and pus 1. The blood Wassermann test and roentgenograms of the pelvis were negative.

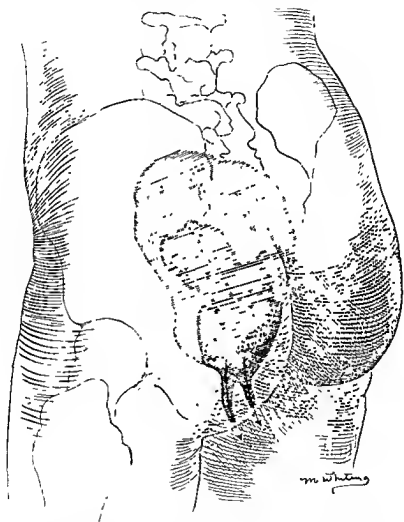


Fig. 307.—Shaded area represents size of the cyst when distended; dark area represents sinuses and cysts as revealed at the time of the operation.

December 6, discharging sinuses and a multilocular dermoid cyst lying between the rectum and the sacrum and extending upward on the left side to the brim of the pelvis were excised (Figs. 306, 307) The sinuses led through a dense, chronic

inflammatory mass of subcutaneous and scar tissue into a cyst (Fig. 308, *a*), containing a large amount of thick foul material, and lined with squamous epithelium which rested on a dense fibrous connective-tissue base, in which no hair follicles or sebaceous cysts were found. A smaller cyst (Fig. 308, *b*) contained a fatty substance of sebaceous character. The wall,

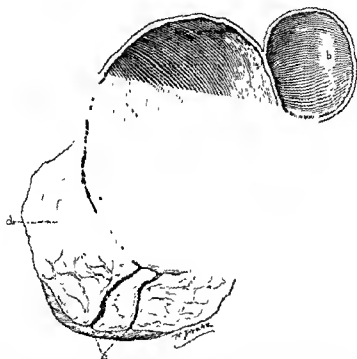


Fig. 308—(*a*) Large infected cyst, (*b*) cyst containing sebaceous-like material, (*c*) postoperative sinuses, and (*d*) piece of bony material embedded in sac

however, showed no signs of epithelium; it was composed of a dense hyalinized tissue containing a large amount of calcareous material which gave rigidity to the wall, making it appear like a shell. The patient recovered uneventfully and was dismissed November 30. At this time she had a small sinus leading to the cavity which contained 50 c.c., which, I believed, would close rapidly.

NOTES ON TECHNICAL DIFFICULTIES OF SURGERY OF THE THYROID

JOHN DE J. PEMBERTON

In view of the excellent end-results of surgery of the thyroid and the very low operative mortality (0.58 per cent in all patients with goiter and no deaths in over 1,000 patients with nontoxic goiters, including cancer), one is prone, unwittingly, to look on subtotal thyroidectomy as being an operation peculiarly free from serious technical difficulties. Yet when the possible complications which may be encountered are itemized, the array at once becomes varied and formidable. It is only by becoming thoroughly familiar with these, either by actual experience or by repeated discussions, that we can hope to reduce their occurrence to a minimum.

In order to discuss the complications systematically, although necessarily discursively, they may be classified in relation to the fundamentals of the operative procedure. While the plan of the execution varies with different surgeons, the principles of technic are constant and uniform. These are: (1) The removal of sufficient thyroid gland, (2) the preservation of thyroid tissue to maintain adequate function, (3) the control of bleeding (hemostasis), and (4) the avoidance of sepsis and injury to neighboring structures. Although not fundamentally important, the completion of the operation with reasonable dispatch and the avoidance of prolonged general anesthesia, are greatly to be desired objectives and should be earnestly attempted.

The removal of sufficient thyroid gland.—In operating on the thyroid gland, the common error is one of omission, that is, failure to remove concealed enlarged parts of the thyroid. This usually results from: (1) Resecting the "top" of the gland without elevating the lobe, thereby overlooking substernal and

retrotracheal projections, with the result that hyperthyroidism or pressure symptoms, or both, persist, and (2) probably one of the most common errors in surgery of adenomatous goiter, failure to *examine* the clinically smaller lobe. Experience teaches the difficulty of accurately measuring the growth clinically. If a patient has a prominent cervical enlargement on one side of the trachea, the presence of even a very large growth on the opposite side may escape detection entirely, owing to the preconceived idea that the growth is limited to one side. In certain cases intrathoracic tumors of far greater dimensions than the cervical enlargement itself are thus overlooked. More than 3 per cent of the patients with substernal and intrathoracic goiters admitted to the Clinic have had previous operations. "Recurrence" of adenomatous goiters in patients who were operated on for the first time before their twenty-fifth year are practically all enlargements of adenomas undiscovered at the time of the first operation. Obviously it follows that as a routine at every operation both lobes should be examined by outlining the limits of the lobe with the finger. Again, not infrequently masses of adenomatous tissue detached from the thyroid gland are present above the superior pole, in the posterior cervical triangle, or, most often, substernally, and are easily overlooked. If systematic search is made in a large number of cases of goiter, probably in 50 per cent, a well-developed pyramidal lobe will be found, sometimes extending as high as the hyoid bone, which, if not removed, almost invariably enlarges into an *unsightly deformity*, annoying to the patient and embarrassing to the surgeon.

Preservation of thyroid tissue adequate to maintain function.—In determining the amount of thyroid tissue to be saved, two considerations should be kept in mind: (1) The conservation of the normal functions of the thyroid gland, that is, the maintenance of metabolic processes at a normal level, and (2) the formation of an effectual barrier against injury of important structures, particularly the recurrent nerve and the parathyroid bodies. In the latter consideration, the size of the lobe, the character of the gland, and the possibility of preexisting damage

of the nerve or parathyroid on one side, are important factors. Theoretically in all goiter operations we are faced with two

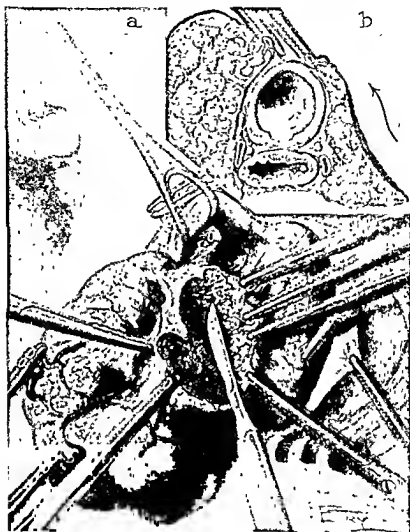


Fig. 309 —(a) Method of resecting the lobe from within out. The middle thyroid veins have been divided and ligated, the right lobe elevated, the superior pole divided and ligated, the suspensory ligament and the isthmus divided and resection of the lobe started. (b) The resected right lobe. Note the site of the preserved segment of gland which forms effectual barrier against trauma to the nerve

seemingly equal possibilities of danger: The resection of too much glandular tissue with resulting myxedema, and the preservation of too much, resulting in recurrence of the goiter. Practi-

cally, however, neither of these are frequent sequelæ of the operation of subtotal thyroidectomy as performed today (Fig 309). Of the two, by far the more common error is failure to remove sufficient tissue.

The minimal volume of the thyroid gland which must be saved in order to maintain metabolism at normal levels obviously is dependent on several factors: Chiefly the character of the gland tissue, adequacy of its blood supply, and the age of the patient. The amount of normal thyroid tissue needed to conserve health is not accurately known, but unquestionably it is much less than provided by nature, and experience shows that when tissue equivalent to *one-fifth or one-sixth* of a normal-sized lobe has been preserved on either side of the trachea, symptoms of thyroid insufficiency do not develop. In certain types of goiter, notably in the diffuse colloid adenomas, as no part of the gland is normal, the amount of this tissue required should be considerably greater, possibly equivalent to *one-third or one-half* of a normal sized gland. It is generally believed that in cases of exophthalmic goiter (diffuse hypertrophy and hyperplasia) because of its greater functional activity, the least amount of gland is required to maintain function. This is probably true, and in most instances very little tissue will suffice, but in my experience the incidence of postoperative myxedema is greater in this type of goiter than in all others, and the amount of gland tissue usually preserved varies from *one-fifth to two-thirds* of the normal sized gland. I believe, therefore, that the development of thyroid insufficiency is not due so much to the removal of too much of the gland as to atrophy and fibrosis of the preserved glandular tissue. The incidence of the secondary inflammatory changes in the thyroid gland, that is, round-cell infiltration and fibrosis, is far greater than in other types of goiter. In an unselected series of 500 cases of exophthalmic goiter thyroiditis was severe enough in fifty-four to be noted on the pathologic report. When the process is greater than moderate, the patients are reexamined within two or three months, and the occasional patient who develops myxedema is almost limited to this group. As the process is diffuse and usually progressive, ultimate myxedema is probably

inevitable, and, therefore, the amount of tissue that should be preserved is of less importance. A degree of thyroiditis is found with nearly all such goiters of long standing, and when severe it can be readily detected at operation by the hardness, toughness, and increased friability of the gland. When the condition is suspected, it should always be confirmed microscopically before resecting the second lobe, so that the tendency to glandular atrophy may be compensated for by the preservation of more thyroid.

The fact that an adequate blood supply to the remaining portion of the gland is necessary for subsequent growth as well as for the maintenance of normal function, may occasionally be utilized to advantage. At times, on the completion of resection of a large goiter, it is discovered that an excessive amount of tissue has been preserved on one side, probably for the purpose of protecting the nerve, but at the risk of recurrence of the goiter. In such instances this danger can be safely and effectually thwarted by ligating the inferior thyroid artery at a point proximal to its entrance into the gland.

The age of the patient should be a factor. On the theory that in the young, owing to body growth, greater activity, and the phenomena of menstruation and child-bearing, there are greater demands on the thyroid gland to meet these wide fluctuations in normal metabolism, a greater amount of thyroid tissue should be saved. Similarly, it can be logically argued that in older patients, due to less demand on the gland, the possibilities of subsequent enlargements are correspondingly less, and accordingly, larger portions may be safely preserved without risk of recurrence. De Quervain believes that new formation of goitrous tissue is dependent on the age of the patient. In 94 per cent of his series of 101 cases in which operation was performed for recurrence, the patients had been operated on for the first time before their forty-first year. It can be readily appreciated then that, while there occurs an occasional post-operative myxedema, only partly accounted for by the resection of too much tissue, the error of preserving too much with the risk of recurrence is much more probable.

Hemostasis.—As a possible complication of the operation we are chiefly concerned with the secondary or late hemorrhage, for, with our present-day methods of surgery, the primary control of bleeding rarely ever offers any serious difficulty.

In view of the extreme vascularity of the thyroid gland, and the fact that the remnant of the resected lobe is freely movable with every act of swallowing and coughing, it would be natural to expect secondary bleeding to be a fairly common complication, but, as a matter of fact, it is not.

The causes of this accident are the result of one of two errors in technic: either dependence on mass ligation for effectual hemostasis, or carelessness in ligating the thyroid veins. Both errors are usually easy to avoid. By placing a separate ligation around each forceps and relying on mass suturing only to control any remaining oozing from the cut surface, the bleeding from the gland can be safely controlled in most instances. In some cases, especially of colloid adenomatous goiter, when considerable tissue has been left, requiring much suturing to control oozing, it may sometimes be safer to ligate the inferior thyroid artery in addition. Again, in certain bad risk patients with large friable exophthalmic goiter, when effectual hemostasis is not certain, it may be safer to pack and leave the wound open, thus permitting escape for any oozing and thereby avoiding all possibility of mediastinal bleeding or choking from retained clots. Secondary venous bleeding can always be prevented by having the patient strain, as by coughing, while on the operating table, to test insecurely tied vessels.

Avoidance of infection and injury to neighboring structures.—Except in rare instances of acute or subacute thyroiditis, wound infections must always be charged to operative or postoperative error in technic. The blame is about equally shared. In the operating room the chances of introducing infection are far more numerous, but because of the perfection of the present-day standards, actual breaks in technic are the exception, while outside the operating room the chances of contaminating the wound are not so apparent, but there is likely to be a tendency toward carelessness in dressings. Therefore, wound infection

is never excusable, but fortunately is rare; only in the exceptional instance does it jeopardize the life of the patient or even the success of the operation. Seemingly the greatest potential danger from wound infection is the development of mediastinitis, but owing to the fact that the bed of the thyroid gland is ordinarily well walled off by the deep cervical fascia, direct extension of the infection is usually effectually limited. Only in the occasional case of a large substernal or retrotracheal projection or in the case in which deep cervical fascia has been opened at operation, does the possibility of this complication become likely. A serious and not unusual danger from wound contamination is the destruction by infection of the remaining parenchyma of the thyroid gland, resulting in the development of myxedema.

Any of the structures in close proximity to the thyroid may be accidentally injured during the operation. These include the recurrent laryngeal nerve, the parathyroid bodies, the trachea, and the internal jugular vein.

Injury to the recurrent laryngeal nerve.—Among the common technical accidents in surgery, injury to the recurrent laryngeal nerve is chief in importance: (1) Because of the relatively high incidence of injury due to the intimate relations of the nerve to the gland and the inferior thyroid artery, and (2) because of the possible grave consequences. In a previous article on the significance of injury to this nerve and its prevention, I endeavored to show that the usual site at which trauma (suture and clamp) to the nerve is inflicted, is not posterior to the capsule of the gland as commonly believed, but in the groove between the mesial surface of the resected lobe and the lateral wall of the trachea, and suggested adherence to two principles of technic: preservation of the posteromedian portion of the lobe, and avoidance of exposing the lateral wall of the trachea. The effectiveness of the method has been unquestionably proved by practice. However, in certain types of growths of the thyroid, additional precautionary measures are sometimes necessary in order to avoid trauma. In removing the larger adenomas that lie adjacent to the side of the trachea, the lateral

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tions of surgery of the thyroid, it is exceedingly infrequent, of moderate severity, easily yielding to the administration of calcium, and practically always transient. The incidence does not exceed 0.2 to 0.3 per cent, and in my series, with one exception, this complication has occurred only as a result of operations on recurrent goiters. The exception was in a patient with chronic thyroiditis superimposed on exophthalmic goiter. The complication should always be kept in mind when operating on recurrent goiters, and care taken to preserve a generous portion of the gland.

Considering its intimate relation to the thyroid gland, the trachea has been singularly free from injury. Trauma, such as clamping and cutting, is the result of carelessness, and is easily avoided. Compression of the trachea by the weight of the forceps or by pressure from a retrotracheal enlargement during the elevation of a lobe, is sometimes suddenly encountered, but is always easy to correct. Rotation with compression of the trachea is likely to occur in the elevation of the lobe in recurrent goiter, unless special effort has been previously made to free the gland from the front of the trachea. In such cases the lobe is attached over a broad surface to the trachea by firm adhesions, and failure to free these before attempting to elevate the lobe may result in partial suffocation of the patient.

The internal jugular vein may be injured in one of two ways, either by tearing off the middle thyroid vein at its entrance into the jugular, or by cutting it unknowingly during the elevation of an adherent lobe. The latter accident is most common in operations for recurrent goiter when the vein has adhered tightly to the lobe of the thyroid. Injury of one of the internal jugular veins is never of serious consequence, provided the accident is immediately recognized and means are taken to remedy it, as one vein may be ligated with impunity, but obviously very serious complications may follow when a damaged vein is unrecognized.

The mere recitation of the list of possible technical errors would suggest that the operation for subtotal thyroidectomy can

arrangement of the blood supply Physiologically the rôle of the acid in, as well as of the nerves to, the stomach as factors in producing the lesion is debated. The pathologic evidence that ulcers heal, and the part that bacteria play in the etiology and maintenance of the chronicity are questioned The value of the results of test-meals in relation to ulcer is doubted It has not been established that all ulcers can be cured by medical treatment The rapidly changing procedures employed by the surgeon in treating ulcer proves that no one method has been wholly satisfactory Peptic ulcer thus appears as a lesion surrounded by many unsolved problems

I shall here attempt to evaluate two factors, the chemical and the mechanical, in the production and in the prevention of healing of peptic ulcer, by a correlation of our experimental observations. It should be noted that I have used acid to denote the active chemical agent, although it is recognized that the enzyme is also a factor I wish to emphasize that while these factors are considered of great importance, no attempt is made to explain ulcer wholly on a chemical and mechanical basis, and it must be recognized that other important factors are involved

We have studied in our laboratories three important problems associated with ulcer that can be considered from a chemical and mechanical aspect (1) How an ulcer forms, (2) why it becomes chronic, and (3) how it heals The first and third problems will be considered first, since the solution of the second depends on them. Only such data as have a bearing on the chemical and mechanical factors will be presented; the complete study of the development and healing of the experimentally produced peptic ulcer will not be considered

Williamson and I have previously reported a method for the experimental production of peptic ulcer in the dog. The characteristic lesion, peptic ulcer, usually occurs in mucosa (pyloric and duodenal) which secretes alkali, but at the same time is exposed to an acid medium. It would thus seem that the acid might be a direct or indirect factor in the cause of the lesion Our results in a preliminary series of experiments in which acid was admin-

istered orally, as well as the results of previous investigators, has made it evident that simulation of the so-called hyperacidity and hypersecretion would be very difficult by the artificial administration of acid. As was reported in the previous article, the degree of acidity and the amount of acid to which the ulcer-bearing area of the gastro-intestinal tract is subjected depends not only on an acid-producing mechanism, but on an alkali-producing mechanism. The acid secreted by the gastric mucosa must be neutralized before the action of the pancreatic enzymes can be effective. The neutralization not effected by the food must be effected by this alkali-producing mechanism, which consists of three secretions: the intestinal (also that of the pyloric mucosa), the pancreatic juice, and the bile. These combined secretions must contain enough alkali to neutralize the acid that passes the pylorus if digestion in the intestine is to be carried out normally. The upper portion of the intestinal tract can be subjected to an acid medium just as effectively by damaging the alkaline mechanism as by the administration of acid. We therefore undertook to eliminate singly, and in combination, the various constituents of the alkali-producing mechanism, and found that the damage of any one of these constituents caused the development of a typical chronic peptic ulcer in a small percentage of experiments. Also, if the duodenum was removed, and the jejunum, with the common bile duct and pancreatic duct transplanted into it, made to occupy the position formerly held by the duodenum, a typical chronic peptic ulcer developed in a few instances. When the duodenum was not molested and the common bile duct and pancreatic duct were transplanted into the terminal ileum, ulcer also developed in a small percentage of cases. Finally a method was devised which consisted essentially in draining the alkaline secretion poured into the duodenum into the ileum, at a considerable distance from the point of emergence of the acid into the intestine. Briefly the procedure is as follows: The pylorus is sectioned and the distal end closed. The first portion of the jejunum is sectioned and the distal end anastomosed to the pylorus. The proximal end of the jejunum is drained into the ileum at a distance greater than

occurring in man, that the procedure adopted offered a means of studying many phases of the ulcer problem that could not possibly be observed in man. For instance, it was possible to observe the development of the ulcer from its first appearance until it became chronic, and if it could be made to heal, the process of healing could be studied. The opportunity was afforded of determining many facts concerning a lesion very similar to the one occurring in man. However, all our conclusions apply strictly to the experimentally produced ulcer. In this connection it should be recalled that while acute peptic ulcers are easily produced by many different methods, chronic peptic ulcers of a type similar to those in man have rarely been produced. Recently Dott and Lim have reported the production of chronic peptic ulcers following gastro-enterostomy with pyloric occlusion. Exalto produced a few ulcers by a modified Y operation. Good reviews of the literature on the subject are given by Bolton, Butsch, Durante, Greggio, and Ivy.

2 How frequently are the ulcers produced? While a few of the dogs have not had ulcer after draining the duodenal contents away from the point of emergence of the acid, it was usually due to failure to drain the duodenal contents into the ileum at a sufficient distance from the pylorus. In a series of twenty-two experiments recently carried out by Willan, who was working on the bacteriologic phase of the problem, ulcer developed in each experiment. It would seem that if the procedure is carried out properly, ulcer will occur in at least 90 per cent of the experiments.

3 Are the ulcers due to malnutrition? It has been shown that ulcers of the stomach and duodenum may rarely occur in conditions associated with malnutrition, and it has been suggested that these ulcers might be of similar origin. Such a consideration is very pertinent in view of the fact that the operative procedure is designed to interfere with the physiologic mechanism of digestion; that it necessarily also changes the mechanics of the digestive tract and greatly decreases the length of intestine in which pancreatic digestion and the absorption of products of digestion may take place. The animals

have usually been weighed once or twice a week after operation. There is usually an initial loss of about 10 per cent of the body weight, then the weight remains approximately the same for some time, when it decreases suddenly. We have proved by exploration and by study of the symptoms, such as vomiting, that the sudden decrease in weight follows the development of the ulcer. If the ulcer perforates and peritonitis results because the perforation is not walled off, the animal may die while still fat and in excellent condition. In some instances the ulcer has developed without greatly interfering with the emptying of the stomach. Such animals remain in good condition for many weeks with the ulcer persisting. Furthermore, as will be noted in connection with the discussion on healing, an animal may have one ulcer healing and another forming at the same time. I can thus conclusively assert that these ulcers are not dependent on a condition of general malnutrition. It is, of course, possible that malnutrition, especially of the intestinal wall, may be of importance.

4. Are the ulcers due to operative trauma? Operative trauma has frequently been suggested as a possible cause for the gastrojejunal ulcer, and must be considered in relation to our experimentally produced ulcer. It can be definitely stated that operative trauma is not responsible for these ulcers. This statement is based on the following: The ulcers never begin to form until after the anastomosis has healed. They do not involve the suture line primarily. In certain experiments the operative procedure was carried out as usual except that the duodenum was drained into the jejunum a short distance from the anastomosis of the latter to the stomach. Thus the duodenal contents and gastric juice were poured into the same loop of jejunum. Ulcer did not occur under these conditions. Several weeks after the original operation the animals were explored. The anastomosis of jejunum to stomach was not molested in any way, but by gently palpating it the possibility of ulcer was excluded. The anastomosis of duodenum to jejunum was taken down and the duodenum anastomosed to the lower ileum in the usual manner. Following the latter operation, the ulcers developed

in the usual site and at the usual time. Except for the careful palpation, the site where the ulcer formed had not been touched for months. Furthermore, the palpation usually preceded the formation of the ulcer by several weeks. In this connection it should be noted that many times incisions have been made into the intestine opposite the ulcer in order to observe and measure it; sometimes they have been made every few weeks for several months, and in every instance except one when infection occurred, they have healed and ulcer has never developed in them.



Fig. 314.—An ulcer of the duodenum which produced death by perforation fifty-seven days after transplantation of the bile and pancreatic ducts to a loop of ileum. This illustrates the type of ulcer which can be produced in the duodenum.

5 Are these ulcers a special lesion involving only the jejunal mucosa and not to be compared with duodenal and gastric ulcers? It has been considered, since the method of draining the duodenal contents away from the pylorus makes it necessary to place the jejunum at the point of emergence of the acid, that these may be only jejunal ulcers, and if it is possible to compare them with lesions in man, comparison with the gastrojejunal ulcer only is justifiable. Most of the ulcers I have studied have been produced in the jejunal mucosa because a higher per-

centage of ulcers was obtained by the duodenal-drainage method. However, the same type of lesion, which cannot be differentiated from the lesion occurring in the jejunum, and is similar to the lesion in the duodenum of man, has been produced in the duodenum of the dog by transplantation of the common bile duct and pancreatic ducts into the terminal ileum (Fig. 314). It should be emphasized that the lesions are produced more readily in the jejunal than in the duodenal mucosa, the latter being more resistant to the processes responsible for the ulcers. Chronic peptic ulcers appear to have never been consistently produced experimentally in the gastric mucosa by any method. Kehrer reports some apparent subacute gastric ulcers produced experimentally.

THE DEVELOPMENT OF THE EXPERIMENTALLY PRODUCED ULCER

I have observed the development of these ulcers in some instances from the time when only a slight injury to the mucosa was noticeable until the ulcers were large, indurated, and perforated, and had existed from four to six months. The period after operation before the ulcer begins to develop is quite variable. The ulcer rarely begins to develop before the third week; in many animals from three to four months elapsed before an ulcer appeared. Usually, however, the ulcer begins to make its appearance toward the end of the first month after operation. After an ulcer has once started it develops quite rapidly. While it is difficult to obtain exact data with regard to this point, the following statements are approximately correct, although it should be understood that an ulcer may develop much more slowly. The minimal time necessary for an ulcer to penetrate through the mucosa is but a matter of hours and certainly less than a day. An ulcer may develop in a macroscopically normal-appearing mucosa, perforate, and produce death from peritonitis within from forty-eight to sixty hours. An ulcer may present the typical appearance of a chronic ulcer within three weeks after it begins to develop. An ulcer five months old may appear the same macroscopically as when it was one month old.

The site where the ulcer develops is of great importance with regard to the mechanism *producing the ulcer*. In the experiments in which the jejunum is anastomosed to the stomach, the ulcer usually occurs in the jejunal mucosa just distal to the line of anastomosis. In the beginning the ulcer never involves the suture line, and there is always normal-appearing jejunal mucosa between the upper edge of the ulcer and the gastric mucosa. Later the suture line may be involved, but rarely before perforation has occurred. The ulcer usually develops in the posterior wall of the jejunum and slightly to the right of the axial line of the jejunum. Occasionally another ulcer develops exactly opposite the first, the so-called contact ulcer. When three ulcers occur, which is very rare, the third is located distal and opposite the ulcer in the usual site. Sometimes the ulceration extends in an *irregular form*, but usually it is circular or elliptical. The ulcers that develop in the duodenum following the transplantation of the common bile duct and pancreatic ducts are just distal to the pylorus and on the posterior wall, slightly to the left of the axial line of the jejunum.

The definite and characteristic location of the ulcer can apparently be explained wholly on a chemical and mechanical basis. The ulcer seems to occur in the area where the acid gastric contents strikes first and with the greatest force on being expelled from the stomach. The ulcer always appears to begin at the spot where the gastric contents would strike the intestinal mucosa after emerging from the stomach. The ring of mucosa just distal to the stomach is protected from the main stream of the gastric contents. The ulcer develops in a different location when the jejunum is anastomosed to the stomach from that when the duodenum is left intact, because in freeing and sectioning the pylorus in the former procedure the point of fixation of the stomach is changed. The contact ulcers appear when the force of the stream is divided. The occasional third, distal ulcer is probably due to what can be termed a splash of the contents from the area of the first ulcer.

Macroscopically the ulcer first appears as a saucer-like depression in the mucosa. In the very earliest stage all that can

be seen is a small area covered with a homogeneous gray material. When this material is gently sponged off a slight depression is uncovered where the edge of the mucosa has disappeared and which bleeds very profusely. This gray covering has been noted in all ulcers that have not penetrated beyond the mucosa. Often it was the only means of recognizing a beginning ulcer, the mucosa otherwise appearing normal. After the mucosa is eroded the process may proceed very quickly until the entire wall of the intestine is perforated, and either death from peritonitis occurs or the perforation is closed with an adjacent organ, such as the pancreas, liver, gallbladder, or a loop of intestine.

There is no doubt that the visible signs of the beginning of the ulcer are due to the acid. The gray covering is composed of mucosa cells killed and coagulated by the acid. An identical lesion can be made in normal jejunal mucosa by the careful application of strong hydrochloric acid. After the mucosa has been destroyed other factors may also be involved, such as infection.

Microscopically the earliest ulcers examined have shown the covering of mucosal cell debris and considerable hemorrhage between the underlying and adjacent tubules. The ulcers undoubtedly begin in the mucosa and at first only the mucosa is involved, the limits of which are not well defined. As more of the mucosa disappears, leukocytic infiltration occurs and the lesion quickly penetrates below the muscularis mucosa. The ulcer then assumes its well-known characteristic appearance.

A possible mechanical factor in the formation of these ulcers might be mentioned here, although the data at present are too incomplete to evaluate it correctly. In the normal process of digestion the contents pass through the gastro-intestinal tract in an orderly sequence. The gastric contents pass into the duodenum under controlled conditions and the duodenum immediately sweeps them along. Under the condition of our experiments this mechanism is probably destroyed. When the jejunum is anastomosed to the pylorus there is a break in the continuity, muscular and nervous, as well as chemical. Instead of the gastric contents passing as one process from the stomach

through proximal loops of intestine, it passes from the stomach into the jejunum, where the institution of another process is necessary to pass it on. While the pause in the passage of the gastric contents after passing the pylorus may be only momentary, it must be considered a factor in exposing the ulcer-bearing mucosa to the acid for a longer period of time. The same factor is involved when the common bile and pancreatic ducts are transplanted. Even though it is admitted that no one mechanism is essential for the opening and closing of the pylorus and the passage of gastric contents into and through the duodenum, there is no question that the relation of acid and alkali is important in the mechanics of this portion of the gastro-intestinal tract. In this connection it should be pointed out that this relationship between the acid produced in the stomach and the alkaline secretion produced distal to the pylorus is not only of importance with regard to the mechanics of digestion, but that probably there is a more important relationship with regard to the amount of each which is produced over any given period of time. The prevention of the acid and alkaline secretions meeting in the normal site may change the relative, as well as actual, amount produced of one or the other. This also awaits further investigation.

Another mechanical factor which is difficult to evaluate, but which is of undoubted significance, is the size of the opening through which the gastric contents are expelled from the stomach. When this opening was small the ulcers appeared to develop sooner and were more prone to perforate than when the opening was more patulous. This would apparently emphasize a nozzle-like action as being of importance.

That the propulsive action of the stomach is also significant is shown by the results of the following series of experiments: A typical hour-glass stomach was made by completely dividing the stomach in the prepyloric region from the greater curvature to within a short distance of the lesser curvature. Both edges of the incision were then closed, dividing the stomach into two pouches communicating at the lesser curvature through a small opening of about the same diameter as the esophagus. The

larger pouch contained the acid-bearing portion of the mucosa and the smaller pouch all the pyloric mucosa (Fig. 315). These animals, in which the propulsive power of the stomach was

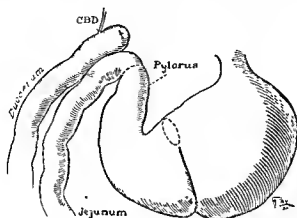


Fig 315—Drawing illustrating the method of making the hour-glass stomach and then operation as illustrated in Fig. 311. Ulcer does not readily occur after the partial division of the stomach.

greatly decreased, have proved most resistant to the development of ulcer.

THE HEALING OF THE EXPERIMENTALLY PRODUCED ULCER

We have not observed the spontaneous healing of any of our proved ulcers. In a few instances some suspicious appearing scars were found, and it is possible that these marked the sites of healed ulcers. In all instances in which an ulcer was proved to be present by actual observation at an exploratory operation, the ulcer persisted until the death of the animal, providing the procedures described below were not employed. Some ulcers have been observed at repeated exploratory operations for from four to five months without any macroscopic evidence of healing.

Since the development of the ulcer seemed to depend in a great measure on the expulsion of the gastric contents on the site of their formation, it seemed desirable to know what would occur if the gastric contents were prevented from passing over the ulcer. Accordingly, in certain animals after an ulcer had developed, the site of the ulcer was explored, the lesion observed,

and measurements taken; in some instances a specimen for histologic study was also secured. Then the pyloric opening was occluded proximal to the ulcer, thus preventing the passage

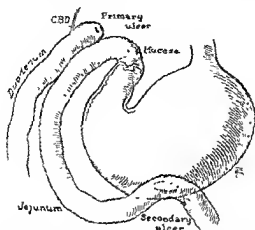


Fig 316—Diagram illustrating the method of causing the ulcers to heal by closing the pylorus and draining the stomach by a gastrojejunostomy

of the gastric contents over it, and the stomach was drained with a gastrojejunostomy, the stoma in the jejunum being 25 to 30 cm. distant from the ulcer (Fig 316)

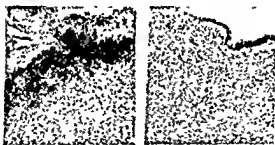


Fig 317.—Section of (left) the edge of a rapidly developing ulcer and (right) the edge of the same ulcer five days after protecting it from the gastric contents. Note the rapid change in the character of the lesion. $\times 100$

Following the foregoing procedure the ulcer healed with remarkable rapidity. Within four days its base was clean and a thin protecting covering had formed over it (Fig. 317). In ten

days the ulcer usually had greatly decreased in diameter and depth, and the mucosa had begun to grow in from the edges



Fig 318—Chronic ulcer which had existed for several months. Note the relation of the ulcer to the suture line. The base was very hard and composed of pancreas and omentum Compare with Fig 319.



Fig 319—The same ulcer as shown in Fig. 318, twelve days after protecting it from the gastric juice. Note the evidence of the healing processes

(Figs. 318, 319). On the twentieth day three-fourths or more of the base would be covered with mucosa. Before the thirtieth

day it was almost impossible to find the site of the ulcer. The rapidity with which the lesion healed was very surprising. An ulcer, 1.5 cm. in diameter and 0.5 cm. in depth, which had perforated the entire thickness of the jejunal wall would almost entirely disappear within twenty-five days after preventing the gastric contents from pouring over it. The base, which was hard and indurated, would become soft and thin, and might bulge like the wall of a diverticulum.



Fig. 320—A perforated ulcer occurring in the efferent loop of a gastrojejunostomy. An ulcer had developed following the usual duodenal drainage procedure. Then the pylorus was occluded and a gastrojejunostomy performed. The original ulcer began to heal, but the animal died on the sixth day following the gastrojejunostomy from peritonitis subsequent to perforation of the gastrojejunal ulcer shown.

In most instances it was not possible to follow the course of these experiments until complete healing had taken place, since they would be suddenly interrupted by the death of the animal due to peritonitis following the development and perforation of another ulcer in the efferent loop of the jejunostomy. Usually within ten to fifteen days after the jejunostomy an ulcer would begin to develop in the efferent loop and quickly perforate the entire jejunal wall (Fig. 320). As in this position there was very little other tissue besides the loops of intestine to plug the perforation, leakage with peritonitis usually occurred. In some

instances at the time the jejunostomy was performed, we wrapped the efferent loop in omentum and this was successful in preventing leakage. In one instance the loop of jejunum was against the parietal peritoneum and the ulcer perforated through the jejunal wall and the abdominal wall, draining the gastric contents to the exterior.

The site of the new ulcer always bore the same relation to the path of the gastric contents as that of the original ulcer. The ulcer developed in the efferent loop of the jejunostomy and apparently at the point where the gastric contents would strike with maximal force after leaving the stomach. As a matter of fact, it was possible to determine the site where the ulcer would develop by properly arranging the efferent loop at the time of operation. If the efferent loop of the jejunostomy was sutured so it would leave the stomach at right angles, and then make a sharp turn 4 to 8 cm. from the stoma, the ulcer always occurred at the site of the bend, even though it was some distance from the stoma.

In these animals interesting and important phenomena were apparent. The original ulcer, which might be very large, hard and indurated, and several weeks old, was healing rapidly after being protected from the gastric contents. Within 30 cm. from the healing ulcer, in the same loop of jejunum another ulcer was developing at the site of impingement of the gastric contents. The two processes, healing of the old ulcer protected from the gastric contents, and the development of the new ulcer in the path of the gastric contents, were going on simultaneously (Fig. 321). In general, everything other than the relationship to the flow of gastric contents was the same for the two ulcers. The general condition of the animal might be good or very poor (the latter due to the effect of the original ulcer), but the processes of healing of the old ulcer and development of the new ulcer were the same. As regards trauma, the site of the ulcer which underwent healing was subjected to much the greater trauma at the operation because it was always explored, measured, and sometimes a specimen of the edge taken. The new ulcer rarely occurred at a point where it could have been subjected to

any special trauma at the time of operation. In this connection it should be recalled that the incision for exploring the original ulcer, except one when infection occurred, as well as the gastroenterostomy incision, always healed.

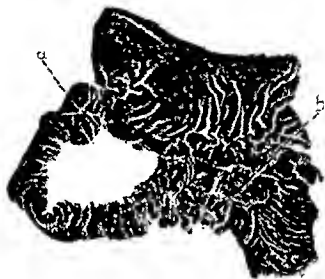


Fig. 321.—Specimen showing the healing of one ulcer (a) protected from the gastric contents and the development of another ulcer (b) in the path of the gastric outflow. The original ulcer (a) was large, perforated, and with a hard base. It measured about 2.5 cm. in diameter and 1 cm. in depth. The pylorus was occluded and a gastrojejunostomy performed. The specimen was secured twenty-eight days after the latter operation. The original ulcer (a) had almost completely healed, measuring about 2 mm. in diameter. Two ulcers had developed in the efferent loop of the jejunum. A small superficial ulcer (to left of ulcer b) measuring 4 mm. in diameter, and a large ulcer (b) measuring 2 cm. in diameter. Ulcer b was not deep, but the base was very hard. It should be noted that at the time ulcer a was first protected from the gastric contents it was larger and deeper than ulcer b.

The closing of the pylorus and draining the stomach by a gastrojejunostomy not only prevents the acid from reaching the ulcer but also prevents any of the gastric contents from passing over the ulcer and probably places at rest the loop of intestine bearing the ulcer (Fig. 322). In order to determine whether the prevention of the acid from reaching the ulcer or

whether the prevention of the mechanical effect of the gastric contents washing over the ulcer was the more important, in one series of experiments, after an ulcer had developed, the duodenum was drained into the loop bearing the ulcer. Thus the alkaline secretion would meet the acid secretion at the point of emergence of the latter and probably neutralize all or most of it and thus protect the ulcer from the acid, but the ulcer would not be protected from the passing of both secretions over it. It was not always possible to drain the duodenum into the jejunum, so the duodenal contents would pass over the ulcer,

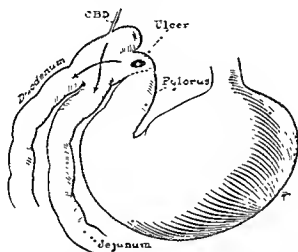


Fig. 322.—Operative procedure employed in draining the secretions of the duodenum back into the ulcer-bearing loop of jejunum. Following this procedure the ulcers heal, but the rate of healing is slower and the process is more irregular than when the ulcer is completely protected.

but certainly a thorough mixing of duodenal and gastric contents took place in the immediate vicinity of the ulcer. In these experiments the results were variable. A certain amount of healing always took place. If the ulcer was located so that after the last operation it was somewhat protected from the contents passing over it, healing took place approximately the same as in the first series of experiments. If the ulcer was fully exposed to the passage of both secretions over it, healing was slow and irregular. When the ulcer was allowed to heal by protecting it completely from the gastric contents, it was possible to esti-

formed in the healing process is very easily injured or destroyed mechanically, as by washing gently with tap-water, and (3) the reparative processes are at all times operative in the ulcer. They probably begin immediately after the injury. The destructive process which produces the ulcer and the attempts of the reparative processes go on simultaneously. However, each protective covering formed over the base is destroyed before healing can take place beneath, and infection recurs. As the delicate cells of the mucosa develop in the edge of the ulcer they are killed or washed away. It is thus evident that the chemical and mechanical factors are very potent in the development of chronicity.

SUMMARY

The probable course of events in the formation and healing of these experimentally produced ulcers, so far as they can be observed macroscopically and microscopically, is as follows: The operative procedure of draining the alkaline secretions away from the point of emergence of the acid exposes the adjacent intestinal mucosa to an acid medium longer than normally. This is due to failure of the acid to be neutralized, and to failure of the gastric contents to be passed along normally. While the whole surface of the mucosa is exposed to the gastric contents, depending on the opening at the pylorus and the propulsive action of the stomach, there are points where the gastric contents strike with greatest force, a nozzle-like action. The ulcer develops on the site subjected to the greatest force of impingement of the gastric contents. The same factors which produce the ulcer prevent it from healing.

While the great importance of the chemical and mechanical factors in the cause of these ulcers and in the prevention from healing has been emphasized, they are probably not the only factors involved. These receive emphasis because they can be readily studied and their effects analyzed. Other factors not so easily seen are probably also operative. If the intestinal mucosa were normal, it seems improbable that impingement of the gastric contents would cause an ulcer to develop. It would seem that there must be some underlying change in the mucosa,

such as infection, or impaired resistance, using the term in a general sense. On the other hand, no lesion will develop in an intestinal mucosa susceptible to the formation of ulcers if it is not subjected to the influence of the gastric contents.

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RAMISECTION FOR SPASTIC PARALYSIS

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The experimental and the clinical work of Royle and Hunter on the sympathetic nervous system in the treatment of spastic paralysis has awakened great interest, and in consequence a number of patients suffering from various types of paralysis have been operated on with varied results. It is particularly noteworthy that it is possible, by means of ramisection, to reduce the spasticity in a selected group of these cases.

Before presenting my own cases I shall quote from Royle's article, "A new operative procedure in the treatment of spastic paralysis and its experimental basis," in which he reviews thoroughly the literature on the function of the sympathetic nervous system, gives the accepted theories of its function, presents the results of his experiments, and advocates ramisection for spastic paralysis.

Royle says that muscular rigidity is the greatest factor in the production of disabilities and deformities in conditions of spastic paralysis, for it minimizes whatever control the patient may have over his muscular system and involves him in a weary process of striving to produce movement against a continual resistance; it is instrumental in producing much more functional disturbance than is warranted by organic lesions. Current methods of treatment based on the accepted physiology of spastic paralysis have alleviated the condition to a certain extent, particularly in young persons, but have not removed the rigidity. From a clinical study of the effects of treatment, it is evident that the hypertonicity and rigidity must be due to some factor other than that which is usually attributed to the influence of the medullated nerve-fibers. Royle quotes Boeke, who proved that voluntary muscles are supplied by nonmedullated fibers

from the sympathetic nervous system besides the medullated fibers from the anterior horn cells. De Boer claimed that he produced a change in the chronic conditions of muscles by sectioning their sympathetic nerves. Langelaan, accepting de Boer's results, maintained that the sympathetic nerves are concerned with the maintenance of plastic tone, whereas the ordinary medullated nerves are concerned with the production of contracted tone. He also quoted from Juno, de Barenne, von Rijnberk, and Cobb, who found that section of the sympathetic nerves failed to influence the development and the maintenance of decerebrate rigidity. These men carried out their experiments on cats. Kuno and Adrian and Wilson reported little difference in the rigidity of the limb following the division of the gray rami. Adrian reports that it is obvious that nothing has been determined definitely concerning the function of the sympathetic fibers passing to voluntary muscles. The fact that they exist and that each muscle-fiber receives a sympathetic fiber is an indication that they have an important function, and it is not unlikely that this undetermined function might have a relationship to the phenomena of spastic paralysis.

Royle's experiments were carried out, therefore, with a view to determine the function of the sympathetic fibers supplying the voluntary muscles, and whether that function was related in any way to the abnormal muscular condition encountered in cases of spastic paralysis. Three sets of experiments were performed. The first, an attempt to reproduce spastic paralysis in animals as it occurs in man, was not successful, and, in order to secure a condition in which hypertonicity appeared in the muscles of the lower limbs, the simple expedient of dividing the spinal cord of a rabbit was adopted. The left abdominal sympathetic trunk was removed immediately after section of the cord. Within a short time it was evident that there was a marked difference in the tonic conditions of the left and right hind limbs. The right limb tended to be maintained in the flexed attitude while the left one hung in an extended position. The amplitude of the knee-jerks also showed an alteration, on the

left side the response was very much less easily elicited and was less than on the right side. Attempts to reproduce this experiment on rabbits were not always satisfactory. It was found that a larger animal, which had a more definite sympathetic trunk, was more suitable, and the goat was used, with the result that the lumbar ramisectomy reduced the spasticity and diminished the reflexes.

The second series of experiments was carried out to determine the effect of removing a unilateral abdominal sympathetic trunk without any previous procedure. The day following removal of the sympathetic nerve supply of the left hind limb the animal walked with a limp, and on the third day it still limped, and the limb appeared to be wasted, probably because the muscles on this side were softer than those on the normal side. On the seventh day the animal still walked with a limp, and when placed on its back could not maintain the left hind limb in an extended position; in the right hind limb there was a firm resistance to passive flexion. There was, also, a coarse irregular tremor in the left limb. Eleven days after the operation the animal could run vigorously; when placed on its back the lower limbs were extended and it was found that the left limb could resist passive movement without evidence of tremor. When both limbs were flexed, the left one fell away from the flexed position. There was no appreciable difference in the amplitude of the tendon reflexes on either side. Similar results were obtained in all the experiments.

The third series of experiments was carried out to ascertain the effect of the division of the sympathetic nerves on decerebrate rigidity. In order to obtain complete decerebrate rigidity it was not sufficient to remove the motor cortex, but it was necessary to destroy the basal nuclei and a portion of the mesencephalon. In one experiment the left abdominal sympathetic trunk was removed, and fourteen days later, after the animal had recovered completely, decerebration was carried out. When rigidity appeared, the condition was so evident in the right hind limb that flexion could only be produced with difficulty; on the left side, however, although extension occurred, the limb could

be much more easily flexed. During the intervals in which there was less rigidity of the hind limbs, striking differences were noticed. If both hind limbs were extended and abducted simultaneously and then released together, the left fell immediately into a completely fixed position, while the right fell slowly, and finally assumed a very much less flexed position. When the knee-jerks were tested in these positions, a strong response was obtainable on the right side; on the left side the response was not greater than that obtained in a normal animal in repose. The animal lived for about twenty one hours after decerebration had been performed.

In view of the gratifying results obtained from these experiments, Royle felt justified in attempting ramisectomy in the human subject for relief of rigidity associated with spastic paralysis. Two willing patients were secured without difficulty.

The first patient had had a gunshot wound of the cerebral cortex. The bullet had entered the skull just above the left ear and had caused an extensive laceration of the cerebral hemisphere in the region of the central sulcus on the left side. The wound had extended across the median line on to the opposite hemisphere, injuring a small area close to the median line. The patient was thirty years of age when operated on; the injury had been received seven years before, following which he had been unable to speak for three months and for more than two years could not walk. Spastic hemiplegia affected both limbs on the right side, the left lower limb was affected also, but only in the leg and foot. He could walk, but had great difficulty in controlling the right lower limb, which he moved as one rigid member. He was unable to stand on the right lower limb, although he could stand comfortably on the left. He could not walk backward or sideways. Operation consisted of division of the gray rami of the second, third, and fourth lumbar nerves, and division of the sympathetic nerve trunk below the fourth lumbar ganglion, through an extraperitoneal lumbar approach. Fifty-four days later the patient could walk with comparative ease, there was marked reduction in reflexes, and disappearance of the spastic rigidity so pronounced before the operation.

The second patient had suffered from spastic hemiplegia on the right side for fourteen years. The upper limb was useless, as the hand was rigidly dorsiflexed at the wrist, flexed at the metacarpophalangeal joints, extended at the proximal interphalangeal joints, and flexed at the distal interphalangeal joints. The forearm was fixed in pronation and could not be passively supinated. The rigidity was so severe that it was impossible to flex or extend a finger passively and the extensors of the wrist resisted forceful passive flexion. The wrist-jerk was exaggerated and followed by a clonus. Operation consisted of avulsion of the gray rami to the whole brachial plexus. The results obtained were again most remarkable, since there was a decided gain in the voluntary control in the patient's perfectly useless hand.

In conclusion, Royle refers to the permanence of the results, and asserts that sympathetic ramisection is a procedure which deals with efferent nerve-fibers and prevents discharge from the central nervous system into the affected muscles. Forster's operation dealt with afferent fibers and it is possible the results were due to interference with the efferent sympathetic return. The whole of the efferent return could not be destroyed and the spasticity tended to relapse. Stoeffel's operation attacked the nerves on the peripheral side, but simply with the idea of reducing a definite amount of nerve supply to the stronger and contracted groups. Results were certainly obtained by this method, and it is not unlikely that here also the plastic tonus of certain muscles was affected because sympathetic fibers were cut in the peripheral neurectomies of the medullated nerves. Obviously in Stoeffel's operation the whole of the nerve supply to a muscle would have to be divided before the rigidity could be totally diminished. Nutt has proposed a complete division of the sciatic nerve, and while this may have some effect on the muscles of the leg and foot, it cannot be applied to spasticity in the region of the hip. The permanence of sympathetic ramisection seems to be assured since it obliterates the channels by which the excessive plastic tonus reaches the muscles.

ALFRED W. ADSON

Martinsville, Ill.

1-8-05
1-13-05
Dear Dr. Adson,

Dear Dr. Adson,

Dear Dr. Adson,

Dear Dr. Adson,

Dear Dr. Adson, I have been
feeling as though I have been
in a gradual improvement
in my condition. My
muscles are steadily becoming
stronger, and I am
beginning to feel as
much better as I have felt
before. I am slowly
gaining strength, my mind
is clearer, and my general
health seems perfect.

I am beginning to do

some things that would
have been impossible before.
The operation I was able to
get up from the floor to
my feet with no aid of
my hand. I am nearly as
surely free from a sitting
position, and am able to
run a sewing machine.

I have been walking
without a cane or any aid
since I was in the hospital.
I walk stiffly at first, but am
beginning to relax and hold
myself in a more upright
position. The last few weeks
I have been walking alone
for short distances out of
doors. That is something
I never attempted to do
before.

I have a system of running
to go through with every day
one at a time, with a few others
occasionally. I am in the
middle of a running track while
in the hospital. I had while
up of a running track or two
suggested, some movements
of the legs, hands, and, while
while grasping a bar, the
last set consists of and
different movements for the
back, legs, and hands, which
I am now to do without
being supported. I am now
through these with much
less fatigue than when
I commenced, and have
increased the number of
times I do each one.

I believe I gain now

Fig 323a -- Copy of letter received seven weeks after patient's dismissal from our care

seems to stay with me,
which are not the first
effort.
With mine within
for a happy and successful
New Year,
Respectfully,
Nathaniel H. H. H.

patient was dismissed from observation twenty-five days after operation (Fig. 323a). The striking postoperative features were the marked diminution in spasticity of the lower limbs and their increased blood volume.¹

Operation was performed in a number of other cases, but inasmuch as the foregoing two cases illustrate the two types of operation, the cervical and the lumbar ramisection, the others will not be reported.

TECHNIC

The technic employed in bilateral lumbar ramisection is as follows: The patient is placed in the Trendelenburg position, a

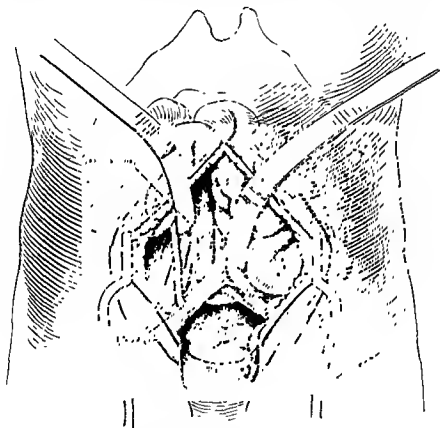


Fig. 324—Mobilization of cecum and small intestine to expose the right sympathetic trunks, ganglia, and rami

median incision extending from the symphysis to a point 7.5 cm. above the umbilicus is made, and the intestines are displaced upward by a pack. The posterior wall of the peritoneum is

¹ Brown, G. E., and Adson, A. W.: Calorimetric studies of the extremities following sympathectomy (In press)

incised on the right side along the margin of the inferior vena cava and the right common iliac vein. The dissection is then carried down to the mesial border of the psoas muscle. The ureter is retracted laterally and the inferior vena cava mesially, exposing the lumbar sympathetic trunk and ganglia, with the gray rami passing along with the intervertebral vessels to communicate with the spinal nerves at the intervertebral foramina (Fig. 324).

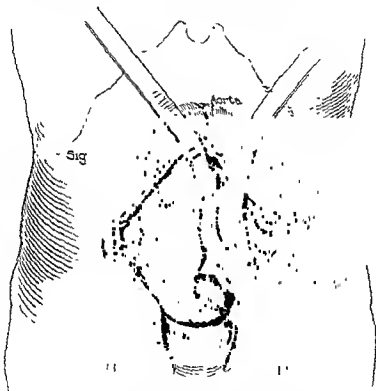


Fig. 325—Mobilization of sigmoid and descending colon to expose the left lumbar sympathetic trunks, ganglia, and rami

Royle advocates only the division of the rami, but I have learned that it is possible also to remove the second, third, and fourth lumbar sympathetic ganglia with the sympathetic trunk, and to divide the rami, without any serious complications of the hypogastric plexus. The technic for the left side is very similar to that employed on the right, with the exception that if the

sigmoid is firmly fixed in the left iliac fossa it is necessary to mobilize it by opening the peritoneum laterally to the sigmoid

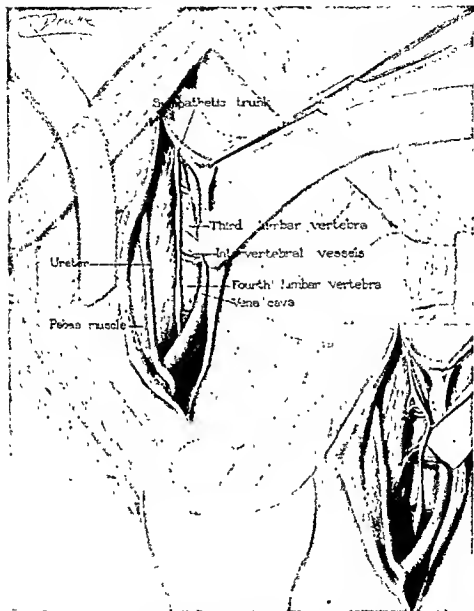


Fig 326 —Postperitoneal incision, exposing the second, third, and fourth lumbar sympathetic ganglia with rami

attachment (Fig. 325). After this it may be elevated and displaced mesially, again exposing the ureter, which is retracted

outward, and while the lower portion of the abdominal aorta and the common iliac artery are elevated, thus exposing the sympathetic ganglia, trunk, and rami. These are excised, as on the right side, after the sympathetic trunk has been carefully divided above the second lumbar sympathetic ganglia and below the fourth lumbar sympathetic ganglia (Fig. 326).

Since information concerning surgical indications was rather meager in the early reports submitted by Royle, I operated on some patients without obtaining the results hoped for. I learned that ramisection is rarely indicated in Parkinson's

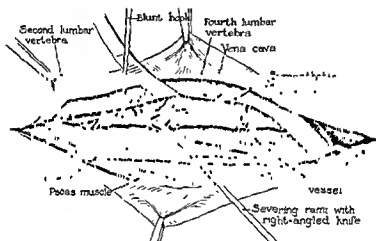


Fig. 327 —Ramisection of the left sympathetic trunks and gray rami

disease. While the procedure does diminish the spasticity to a certain extent it does not arrest the tremor or the progress of the disease, and since these patients are more concerned about the tremor and the arrest of the disease than they are about the spasticity, they are invariably disappointed with results. Neither is ramisection indicated in cases of Little's disease, when the patient has not sufficient mentality to cooperate in the post-operative treatment, or in the presence of marked athetosis, ataxia, or tremor, or if patients are unable to stand and to sit alone. The patient should be at least five years of age and able to cooperate with the surgeon in the postoperative treatment.

Ramisection is likewise not indicated in cases of spasticity following an apoplectic stroke due to thrombosis, when there is likelihood of recurrence (Fig. 327).

CONCLUSIONS

1. Ramisection does diminish spasticity. It is indicated in the milder types of Little's disease which cannot be corrected by orthopedic measures or by Stoeffel's operation.

2. It is of particular value in cerebral birth palsy with unilateral involvement, and is indicated in cases of spasticity due to trauma of the brain, as well as in an occasional case of spasticity following embolus.

3. Ramisection is an additional measure in the treatment of spasticity. The results of ramisection with exercises differ from the results of orthopedic measures alone, since the spasticity diminishes in the course of time following ramisection, while without ramisection it is prone to recur despite the exercises.

EMPYEMA

STUART W. HARRINGTON AND ARTHUR G. PLANKERS

The patients discussed here, who are still in the hospital, demonstrate most of the important points with regard to diagnosis and treatment. While each case should be considered individually the underlying principles of treatment are much the same. In acute cases the first measures must be life-saving; in chronic cases cure must be effected with minimal deformity and loss of function.

Case I.—A boy, aged nine, was brought to the Clinic October 30, 1924. His illness had begun about six months before with a fever of from 103° to 104°. This lasted seven or eight days with pain in the chest and a cough, but with very little expectoration. Slight improvement occurred after several weeks, but the child had never been entirely well since. He had been constipated, and complained of abdominal cramps, which were relieved by frequent enemas. Treatment for high intestinal obstruction had been given several times. Two weeks before admission, he began to have fever daily, a cough, and pain in the chest; he lost appetite and weight rapidly, and became very weak. An x-ray examination at his home revealed fluid in the left chest. He also had clubbing of the fingers.

On examination the skin was dry, the hair scanty and brittle, and the left chest bulged and showed evidence of empyema necessitatis (Fig. 328). There was no expansion in the left chest, the interspaces were bulging and tender, the percussion note was flat, and breath sounds and vocal resonance were absent. The spleen was palpable and the abdomen markedly distended. Urinalysis revealed albumin 2, hyaline casts 2, granular and leukocyte casts, erythrocytes 2, and pus 1. The hemoglobin was 54 per cent. The erythrocytes numbered 4,250,000, and the leukocytes 21,000. The temperature was 101°; the pulse rate was 144 and the respiration rate 28. Roentgenograms showed the left chest filled with fluid, the patient was septic. Therefore, thoracentesis was performed at once, and 850 c.c. of thick greenish pus was evacuated. Culture of the specimen showed pneumococcus, Type III. The patient was relieved for several days, then again became toxic. A catheter was inserted into the seventh interspace below the angle of the left scapula, and closed drainage begun; 600 c.c. of pus was evacuated. Saline irrigations were given every two hours for several days, then hypochlorite was used. A high calorie diet was prescribed which is essential for the debilitated and



Fig 328 —Patient on admission.



Fig 329 —Same patient as shown in Fig. 328, six weeks after closed drainage.

anemic patient. After a week the patient began to improve rapidly. The cavity, with a capacity of 150 c.c. a week after the insertion of the tube, grad-

ually decreased in size. The patient was required to blow in bottles. His abdomen, however, remained distended for several weeks, and he complained of a sharp pain along the region of the left iliac crest during irrigations. Roentgenograms of the hip and spine were negative for possible Pott's disease, and the iliac pain was thought to be due to referred diaphragmatic irritation. With closed drainage for seven weeks, the patient gained 15 pounds; his hemoglobin rose to 65 per cent; there was practically no cough or sputum; the cavity decreased from a capacity of 150 to 15 c.c. The hair became more abundant and glossy; the abdomen decreased in size, and there were no further



Fig. 330—Same patient as shown in Fig 328. x-Ray taken after injection with bromid, showing long narrow cavity

signs of reflex iliac pain (Fig. 329). All tests for tuberculosis were negative. Sodium bromid was injected into the cavity, and the roentgenogram showed a long narrow pocket up to the second rib anteriorly (Fig 330).

January 27, 1925, an open operation was performed. The presence of a long narrow cavity necessitated resection of segments of four ribs, together with the overlying pleura and intercostal muscles. We were unable to unroof completely this cavity because the patient's condition did not warrant such a radical procedure. As he had only a mild postoperative reaction and continued to improve, on February 17, the second stage was performed, consisting of resection of about 5 cm. of the second rib in the axillary line and



Fig. 328.—Patient on admission.



Fig. 329.—Same patient as shown in Fig. 328, six weeks after closed drainage.

anemic patient After a week the patient began to improve rapidly. The cavity, with a capacity of 150 c c a week after the insertion of the tube, grad-

A conservative drainage operation would have been of no value in this case; therefore a primary radical operation for drainage and obliteration of the cavity was performed December 18. A very interesting condition was found. The largest sinus tract was followed downward and backward and found to open into a large cavity which completely encircled a large area of

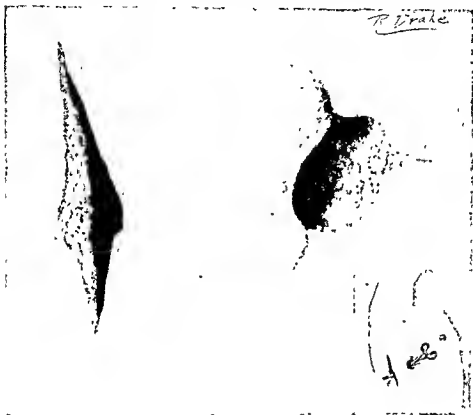


Fig. 331.—One month after open operation, showing the through-and-through open drainage.

firmly adherent parietal and visceral pleura. This condition was probably the result of the original empyema of nineteen years before. The recurring cavity had completely surrounded the adherent pleuræ and extended posteriorly at the vertebral gutter from the sixth to the tenth rib, necessitating a second incision posteriorly and the resection of a segment of five ribs to unroof it completely. The thickened parietal pleura and the

overlying intercostal muscles were removed, and the visceral pleura partially decorticated. The wound was packed with iodoform gauze; later daily dressings of 1 : 7 hypochlorite solution were used. The patient had practically no reaction following the operation (Fig. 331). The wound granulated nicely and was almost entirely healed at the end of four weeks. The patient has continued to improve gradually and gain in weight and strength.

This patient's original empyema had followed pneumonia nineteen years before, and after conservative rib resection he was entirely free from symptoms for twelve years, when he again had pneumonia with recurrence of the empyema. Three operations for rib resection and twenty-two incisions were inadequate for drainage. This case again demonstrates the chronicity resulting from inadequate drainage, the possibility of recurrence following a seemingly perfect cure, and also the necessity of a radical open operation to procure a permanent result.

Case III.—A young man, aged seventeen, came to the Clinic December 22, 1924, with multiple draining sinuses and a drainage-tube in the mid-sternum. He had had scarlatina in 1914, influenza in 1921, pneumonia in 1924, and tonsillitis frequently. His present illness had lasted four and one-half months. In August he had had a sudden sharp pain over the lower end of the sternum, followed by high fever and chills. He was so ill for three days that he was taken to the hospital. The high temperature and pain persisted. About the end of the second week, a furuncle appeared on the outer aspect of the left ankle and also a tender swelling over the lower end of the sternum. The furuncle on the ankle opened and drained pus, but the fever continued. Two days later the swelling over the sternum was incised and pus evacuated. The patient's temperature began to decrease and he felt relieved. Mercurochrome was injected into the chest wound. After three weeks in the hospital the wound on the ankle had healed but that on the sternum continued to drain. The left chest was aspirated with negative results. He was told that he had pneumonia while in the hospital. He returned home and was in bed for three weeks more. The wound in the chest continued to drain. Two weeks before examination, a catheter had been inserted into the wound for a distance of 28 cm. Since his illness the patient had had a slight hacking cough but very little sputum, no hemoptysis or pleurisy.

Examination on admission to the Clinic showed that the patient was fairly well nourished, with a drainage tube in the sinus tract at the left lower sternal border and with a recently closed sinus tract 2.5 cm. below it (Fig. 332). He was somewhat septic. The systolic blood-pressure was 120, the

diastolic 60. Pulse, temperature, and respiration were normal. Urinalysis was negative except for the presence of an occasional red blood cell. The hemoglobin was 78 per cent; erythrocytes numbered 5,260,000, and the leukocytes 12,500. The sputum was repeatedly negative for the bacillus of tuberculosis, sulphur bodies, and spirilla. Repeated smears from the sinus were negative, also the Wassermann reaction. The tonsils were septic. There were distant breath sounds and fremitus in the anterior upper chest, distant breath sounds and absent fremitus posteriorly, with dullness over the left chest from the angle of the scapula down to the base. The left chest was retracted and the patient showed beginning clubbed fingers. Roentgeno-

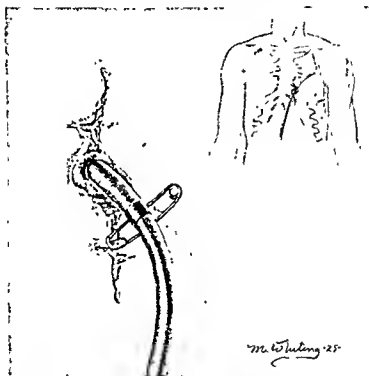


Fig. 332.—Photograph on admission, showing the tube in sinus

grams of the chest showed a thickened and retracted pleura at the left base and the drainage tube inserted to the second rib level.

The patient was weak and septic and was hospitalized for further study. He had lost a good deal of weight in four months. The history and location of the trouble suggested tuberculosis.

Saline irrigations were started to rule out bronchial fistula. Another catheter was inserted and closed drainage begun, with 1:7 hypochlorite irrigations. The capacity of the cavity was about 75 c.c. Another roentgenogram of the chest taken with sodium bromid injected into the cavity showed an area of infiltration in the first and second interspaces on the left side with the tube extending to the level of the second rib. A posterior

exploratory puncture of the left chest was negative. There had been gradual loss of weight in the last four months. After three weeks of preoperative treatment the cavity was reduced to 15 c c. The leukocytes were normal and the patient had gained 10 pounds and was greatly improved. His con-

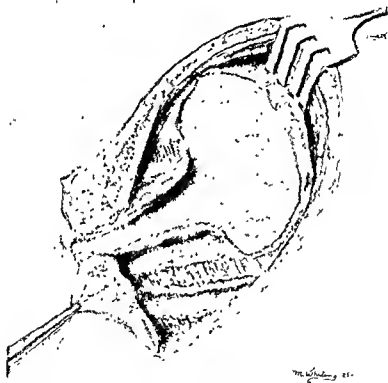


Fig. 333 —Drawing at time of operation, showing shallow pocket. Entire cavity decorticated.

dition remained about stationary for the next week and an open drainage operation was advised.

At operation the sinus tract was found to run laterally between the fourth and fifth ribs on the left, and to open into a large shallow pocket which agreed with the finding at examination. It was necessary to remove from 12 to 14 cm segments of the second, third, fourth, and fifth ribs to

unroof the cavity completely. We excised the overlying parietal pleura, together with the intercostal muscles. The visceral pleura covering the cavity was completely decorticated (Fig. 333). The tissues which were removed were examined microscopically, but no evidence of tuberculosis or actinomycosis was demonstrated.

The iodoform pack was removed after thirty-six hours and the wound packed daily with 1 : 7 hypochlorite dressings for several weeks, after which mercurochrome was used. The patient had practically no reaction following the operation and his convalescence was uneventful. He continues to gain in weight and is entirely free from symptoms. The wound is gradually closing with healthy red granulation tissue, and the patient will soon be dismissed.

This patient presents some very interesting features from the standpoint of diagnosis and treatment. The obscure onset without previous known pulmonary disease and spontaneous drainage at the margin of the sternum producing multiple sinuses strongly suggested a tuberculous or actinomycotic origin, but repeated examinations were negative. The value of proper drainage and the radical operation necessary to unroof completely a cavity to affect a permanent cure are also demonstrated.

Case IV.—A boy, aged fifteen years, came to the Clinic December 17, 1924, with a draining sinus in the left axillary region. He had had influenza three months before, followed by pneumonia, and shortly afterward by pleurisy on the left side. He was acutely ill for two or three weeks, and then began to convalesce. About the middle of June he was able to get outdoors, but continued to have moderate fever, especially in the afternoon, and had profuse night sweats. About the middle of July he had a paroxysm of coughing and suddenly expectorated a teacupful of foul greenish pus. Since then his breath had been foul and he had expectorated copious amounts of purulent sputum. Changing his position would often start a paroxysm of coughing. July 31, a drainage operation was performed and more than a pint of pus evacuated. The patient came to the Clinic primarily for closure of the persistent sinus tract.

The patient was rather pale and sallow. He had lost 24 pounds during the last twenty-seven months. Urinalysis and blood Wassermann reactions were negative. The hemoglobin was 66 per cent; erythrocytes numbered 4,230,000, and leukocytes 25,500. The fingers were clubbed and there was a traumatic perforated nasal septum. Examination of the chest revealed a draining sinus in the left axillary line. There was bronchial breathing with nasal voice sounds in the anterior left base, indicating probable cavitation. Posteriorly the fremitus and breath sounds were diminished. Roentgeno-

lobe with marked interlobar

Saline irrigations produced
sence of a bronchial fistula.

Repeated examinations of sputum and the discharge from the sinus tract were negative for the bacillus of tuberculosis and sulphur bodies. It was impossible to insert a tube through the old sinus tract, owing to the marked fusion of the ribs at that point. The patient was quite toxic and an open drainage was thought advisable. This is always indicated in these chronic septic cases by inadequate drainage, especially when a bronchial fistula is



Fig. 334 — Photograph one week after first stage of the operation

present. These patients likewise do not tolerate the hypochlorite irrigations. Because of the patient's poor general condition a conservative open operation was performed December 30, resecting from 12 to 15 cm. segments of three ribs, together with the thickened pleura and intercostal muscles. About 400 c.c. of foul pus was found in the cavity, and evidence of marked pneumonia. Nine bronchial fistulas were demonstrated with many bridges of granulation tissue between the visceral and parietal pleura and almost total collapse of the upper lobe of the lung. The cavity was loosely packed with iodoform gauze. The tissue removed showed only chronic inflammation (Fig. 334).

The iodoform pack was removed after thirty-six hours and the wound packed with saline gauze for a few days. In spite of the bronchial fistulas 1 : 14 hypochlorite packs caused no discomfort, and after a week 1 : 7 hypochlorite packs were used with no ill effects. The cavity began to clear up nicely. The patient's general condition improved, his appetite became ravenous, and he gained rapidly in weight. The leukocytes dropped to normal.

February 19, 1925, a radical open operation was performed with the partial resection of eight ribs, the parietal pleura, and the intercostal muscles, in order to unroof completely the cavity which extended high in the axilla, with a pocket running posteriorly. All of the fistulas except one had healed spontaneously following the first operation, as is usual with small fistulas. Most of the larger fistulas required independent treatment. We have found the continued application of silver nitrate at weekly or ten-day intervals a most efficient method of destroying epithelial lining and promoting cicatricial closure. The pneumonitis, as well as the cavity, is gradually clearing up. We are keeping the wound open and shall continue to do so until the fistula has healed.

In this case the probable sequence of the disease was influenza, pneumonia, pleurisy with resulting interlobar empyema and rupture into the lung, forming an abscess, which, in turn, had ruptured into a bronchus, producing a bronchial fistula.

Case V.—A man, aged thirty-seven, came to the Clinic August 11, 1924, with a sinus in the left chest. In October, 1923, he began to tire easily, lost strength, and noted shortness of breath. His physician advised tonsillectomy, which was performed a few days later under local anesthesia. Immediately afterward the patient began to cough and a week later began to raise mucopurulent sputum, which later became greenish yellow, but did not have a foul odor. Coughing was most marked when the patient lay on his right side. He lost in weight and strength, and had night sweats, but did not remember whether he had a fever. He was unable to work, and under medical care, but showed no improvement. In March, 1924, his dyspnea became more marked; a diagnosis of left-sided empyema was made, and a catheter inserted with drainage of 2,160 c.c. of pus. The dyspnea decreased immediately; the patient felt relieved, and had very little cough or expectoration. There was no history of pleurisy or pneumonia. The chest was aspirated and irrigated with Dakin's solution for six weeks, no fistula being demonstrated. At the end of this time the drainage was very scanty and mucoid in type. The tube was then removed and the wound allowed to heal. At the end of six days the patient again felt ill, had a cough, and expectorated. Four days later a left partial rib resection was performed, and the sinus had drained ever since, discharging about 60 c.c. of pus every twenty-four hours. Seven weeks before, after jacking up a car, the patient became very dizzy, had headaches, and was generally fatigued. He had been in bed ever since. The condition was diagnosed as influenza. The patient had lost 70 pounds

since the onset of the illness. His appetite had remained normal and he had had no gastro-intestinal symptoms.

When the patient entered the Clinic he was emaciated and looked ill. Respiration was being carried on almost completely with the right chest. The left chest was retracted. There was a sinus in the left axillary line and a drainage-tube was in place. The heart was pulled over to the left. Increased dulness was noted over the left apex posteriorly, with increased breath sounds from the angle of the scapula down. Anteriorly there was increased dulness, absence of breath sounds, and signs of pneumothorax. The right



Fig. 335 —Photograph three weeks after two-stage thoracoplasty, preparatory to open operation

chest was hyperresonant. The muscles around the shoulder girdle were atrophic, there was scoliosis of the spine and clubbing of the fingers. The systolic blood-pressure was 96, the diastolic 60. Temperature was 96°, the pulse rate was 100, and the respiration rate 20. Urinalysis and blood Wassermann reaction were negative. Secondary anemia was marked; the hemoglobin was 57 per cent. Erythrocytes numbered 4,000,000, and leukocytes 8,000. The sputum was negative for the bacillus of tuberculosis and sulphur bodies. The vital capacity was 2,433 c.c. with an estimated normal capacity of 4,735 c.c. The x-ray examination showed a pneumothorax on the left

side with the lung compressed to the second rib level to about one-half its volume. The cavity measured 960 c.c., and, no bronchial fistula being demonstrated, irrigations were instituted with 1:7 hypochlorite solution every two hours. By the end of two weeks the headaches had completely subsided and the patient began to gain in weight and strength. His hemoglobin rapidly increased to 65 per cent. There was no sputum. The cavity fluctuated from 840 to 360 c.c. and back to 840, due undoubtedly to multiple pockets. From September to November the condition of the patient continued to improve, although we were unable to obtain much reduction in the



Fig. 336 —Photograph of patient after the last open operation, showing the separation of pleura following the incisions

size of the cavity. A roentgenogram at this time showed the left lung almost completely collapsed. As the patient had improved markedly, more radical treatment was considered advisable. On account of the large size of the cavity, the operation was performed in stages. The posterior segment of the ribs overlying the cavity from the tenth to the second rib was resected in two stages. November 6, the first-stage extrapleural thoracoplasty was performed, removing a 12 to 15 cm. segment of the ninth, eighth, seventh, and sixth ribs. November 16, a 10 to 12 cm. segment of the fifth, fourth, third, and second ribs was removed (Fig. 335). Closed drainage was continued during this time and the cavity became greatly reduced (250 c.c.). At the

third stage, January 8, 1925, an open drainage operation was performed. The lower portion of the cavity was partially unroofed, removing the ninth, eighth, seventh, sixth, fifth, and fourth ribs to their costal junctions (Fig.

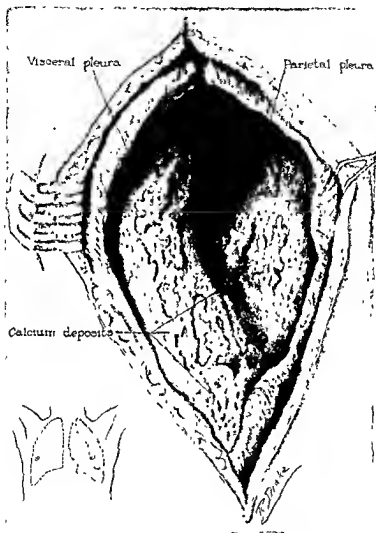


Fig. 337 —Drawing made at time of operation, showing the extensive calcium deposits

336). The cavity proved to be enormous, the left lung being almost completely collapsed. The pleura was markedly thickened, the ribs greatly distorted and triangular in shape. The entire cavity was lined with a thick

layer of calcium deposit (Fig. 337) which also explains the lack of reduction of the cavity under preliminary irrigations. This deposit was removed, together with the overlying thickened pleura, the wound packed with iodoform gauze, and treated as an open drainage case. The last operation was performed February 4, when the anterior segment of the second and third ribs with the pleura and intercostal muscles were removed, completely unroofing the cavity which extended well under the axilla. Recurring calcium deposits were removed. The cavity was still quite large, although reduced. There is still some tendency to reformation of calcium deposits, and healthy granulations are beginning to form. The cavity could be decreased further by turning in muscle flaps, but the patient is very anxious to have no further impairment of the function of the arm. We intend later to use skin flaps to cover over the remaining pocket.

The etiology in this case is very suggestive of the post-tonsillectomy aspiration type of infection, which is not uncommon. Fifty-eight cases of post-tonsillectomy pulmonary suppuration with empyema, probably of the aspiration type, have been observed at the Clinic. In fifty-six of these cases the operation was performed elsewhere. The two operations in this Clinic were performed under local anesthesia. The treatment in this case presents many interesting problems. The size of the cavity could not be much reduced. The fluctuations in its size were found at operation to be due to a bridge of tissue at the base of the upper lobe extending across the cavity, dividing it into two compartments.

third stage, January 8, 1925, an open drainage operation was performed. The lower portion of the cavity was partially unroofed, removing the ninth, eighth, seventh, sixth, fifth, and fourth ribs to their costal junctions (Fig.

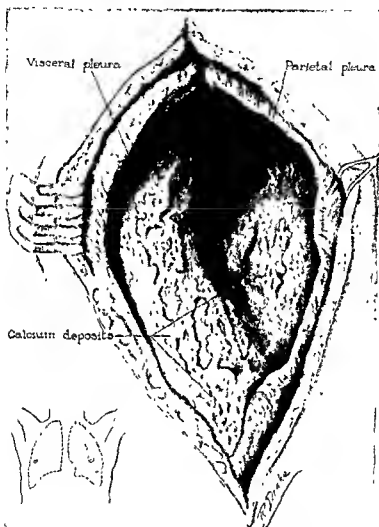


Fig. 337 —Drawing made at time of operation, showing the extensive calcium deposits

336) The cavity proved to be enormous, the left lung being almost completely collapsed. The pleura was markedly thickened, the ribs greatly distorted and triangular in shape. The entire cavity was lined with a thick

FALSE DIVERTICULUM OF THE DUODENUM CONTAINING GALLSTONES, WITH CHOLECYST-DIVERTICULAR FISTULA

VERNE C. HUNT AND WILLIAM P. HERBST

A woman, aged forty-five, came to the Clinic March 20, 1923, on account of stomach trouble, characterized by burning and a sensation of fulness, of five months' duration. The only previous illness of any consequence had been typhoid fever in 1921. Symptoms were not continuous, but occurred in attacks lasting several days, followed by complete remission for a few days. Pain, due to retention, was completely relieved by vomiting. She had been treated for gastric ulcer.

Roentgen-ray examination of the stomach revealed pyloric obstruction, for which exploration was advised. At operation a tumor, about 4 cm. in diameter, hard in consistency and involving the entire circumference of the pylorus, was found. The growth was characteristic of malignancy, except that it was smooth, and involved the duodenum more than is usual in carcinoma of the pylorus. The duodenum and the tumor were densely adherent to the gallbladder (Fig. 338), and the great omentum covered all of these structures, apparently protecting from perforation. Because of the absence of glandular involvement and the gross appearance of malignancy it seemed advisable to remove the tumor by pylorectomy.

In mobilizing the duodenum and freeing it from the gallbladder which contained stones, a fistulous communication between the gallbladder and tumor was divided (Fig. 339). The tumor was excised by pylorectomy and a posterior Polya end-to-side anastomosis made, with subsequent cholecystectomy. Not until the pyloric tumor was sectioned was its true nature suspected. It proved to be a dissecting diverticulum of the

duodenum almost completely surrounding the latter (Fig. 340), filled with numerous impacted gallstones, which had been discharged from the gallbladder by way of the fistulous communication. The opening between the diverticulum and duodenum was at the superior border of the duodenum, but was not large enough to allow the passage of stones (Fig. 341). The patient's convalescence was uneventful and she was dismissed from observation thirteen days after operation.



Fig. 338.—Appearance of diverticulum on opening the abdomen

Diverticulum of the duodenum has been seen chiefly at necropsy. In a recent review of the literature we found 142 cases diagnosed at necropsy, 133 diagnosed by the x-ray but not confirmed by operation or necropsy, and sixteen in which the condition was disclosed at operation. Three cases in which the diverticulum contained stones are reported in the literature. The first case was reported by Chomel in 1710 Harley, in 1875, reported a

diverticulum containing one large stone, in which no definite communication between the diverticulum or duodenum and

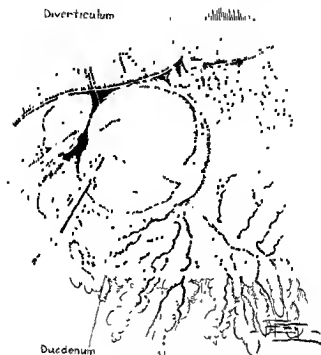


Fig 339 —Division of the cholecyst-diverticular fistula.

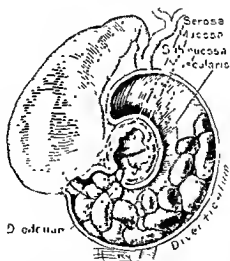


Fig. 340.—Relation of diverticulum to gallbladder.

biliary apparatus could be demonstrated. In the absence of a demonstrable communication, the source and nature of the

stone are open to conjecture. The development of concretions within the diverticulum is a plausible explanation of the presence of a stone when no communication between diverticulum and hiliary apparatus exists. Cole and Roberts reported the third case in 1920; operation was performed by Erdman.

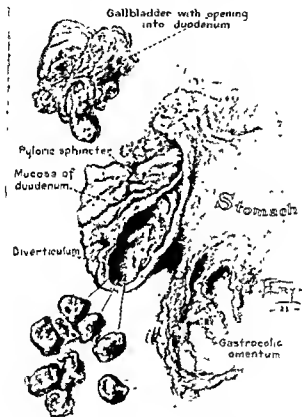


Fig. 341 —Relation of diverticulum to duodenum

That the stones in the diverticulum in our case were certainly gallstones is attested by their exact similarity in color, size, and consistency to those contained in the gallbladder, and the presence of the cholecyst-diverticular fistula.

In the Mayo Clinic up to January 1, 1924, twenty-seven

cases of diverticula have come to operation, and twenty have been seen at necropsy. This case, however, is the only diverticulum in the series containing gallstones.

The surgical procedure in this case is deserving of comment. The solid impaction of the stones produced a smooth rounded tumor, firm in consistency, in which there was no crepitation, with every appearance of being solid. The radical procedure was adopted on the basis of the gross appearance of malignancy of the pylorus. Had the true condition been recognized the operation would have been less radical. Most diverticula, in the absence of associated disease, are amenable to local excision or to invagination into the duodenum, as described by Lewis.

In six of the twenty-seven cases operated on duodenal ulcer was associated, and gastro-enterostomy was performed in five cases, in four of which the diverticulum was also excised, invaginated, or destroyed by the cautery with suture of the duodenum. A Billroth No 2 resection was performed in the other case.



URETERAL STONES

HERMON C. BUMPUS, JR., AND ALBERT J. SCHOLL

Operations for the removal of ureteral stones are of comparatively recent date. Jeanbrau credits Bardenheuer with having performed the first ureterolithotomy in 1882. The technic of the operation was developed and described by Tuffier in 1888. He incised the ureter longitudinally and sutured the opening after removal of the stone. Healing was obtained without disturbance of the function of the kidney. Jeanbrau, as late as 1909, was able to find in the literature only 172 cases of surgical removal of ureteral stones. Israel, in 1912, reported sixty-one cases. The next large group, a series of 230 cases, was reported by Braasch and Moore in 1915.

When Jeanbrau and Israel reviewed their cases the ureteral catheter was coming into general use. Since then the refinements and accuracy of the roentgenograph, and more recently the technical efficiency of ureteropyelography, have greatly facilitated the identification and localization of ureteral calculi, so that at the present time the correct diagnosis of stones in the ureter is not difficult. This increased technical skill has also produced great modifications in the method of treatment. Whereas formerly the ureteral stones were invariably removed by operation, we now find that competent cystoscopists are removing a great many through the bladder after manipulation by means of ureteral catheters. Crowell reports removing eighty-eight stones, in a series of ninety-eight cases, and Bugbee in a series of 347 cases used the bladder route successfully in 326. That the majority of ureteral stones are of renal origin and that many of them will pass successfully through the ureter, was known to the ancients, who considered the open ureter a form of natural defense against the permanent lodgment

of stones in the kidney. Aretaeus says "Nature did well in forming the cavity of the kidneys oblong, and of equal size with the ureters, and even a little larger, so that if a stone formed above, it might have ready passage to the bladder."¹

It is, of course, impossible to estimate the exact proportion of stones that pass unaided, but it must be considerable, for most ureteral stones are single, and many small smooth stones pass the ureter to the bladder with little or no colic. Jeanbrau found that multiple stones had been reported in only twenty-one of a series of 220 cases. When this occurs there is usually considerable associated renal infection and much impairment of function.

In an occasional case stones may develop at the site of ureteral trauma or as a result of operative procedures, although it is usually impossible to determine the cause definitely. In one case a ureteral stone was found impacted at the ureterovesical juncture nine years after transplantation of the ureter, following resection of the bladder for cancer.

In 425 cases of the present series, 314 surgical and 111 manipulative, the stone was in the right ureter; in 449, 320 surgical and 129 manipulative, the stone was in the left ureter; in six cases the side was not definitely stated.

Impaction of the stone in the ureter depends on the volume, shape, and surface of the calculus, and it occurs, usually, at the sites of normal constriction in the ureter. The most important of these are, first, at the bladder wall, second, at the point the ureter crosses the iliac vessels, and, third, just below the renal pelvis.

✓The constriction at the bladder wall is the most common site of obstruction to ureteral stones, particularly the point of termination of the ureter on the mucous surface of the bladder. In an occasional case the stone or multiple stones may pass through the bladder wall, but, failing to pass through the ring of mucous membrane which pouches into the bladder, form a ureterocele containing stones.

The ureter is divided roughly by its points of constriction into several definite segments, the upper or lumbar, the middle or iliac and lower or pelvic thirds, with several subdivisions.

Jeanbrau found the stone in the middle or upper ureter in sixty-one of 204 cases, and in the lower in 141, of which thirty-six were in the segment of ureter passing through the bladder wall. Israel found 20.7 per cent of stones in the upper third, 11.3 per cent in the middle ureter, and 64.1 per cent in the lower ureter. Three and seven-tenths per cent were located in the bladder wall. Pappa found seventy-seven of 131 stones in the lower ureter, thirteen in the iliac or middle portion, and forty-two in the lumbar region.

Between January 1, 1901 and January 1, 1924, 880 cases of ureteral stone were treated at the Mayo Clinic. Of these, 640 were removed surgically, and 240 were removed by cystoscopic manipulation during the later years.

Location of stone	Operative removal	Manipulative removal	Total
Ureterorenal juncture	64		64
Upper third or lumbar segment	71	1	72
Middle third or iliac segment	41	18	59
Iliac crest	11		11
Lower third	311	118	429
Ureterovesical juncture	88	63	151
Intramural	36	24	60
Not stated	26	16	42
Total	648*	240	888

* Including eight bilateral operations

Of the stones whose location was known, 76 per cent were in the lower third of the ureter. Practically all very large ureteral stones, and usually multiple small stones, are found lodged just above the bladder (Figs. 342, 343). Not infrequently stones of moderate size, from 1 to 2 cm in diameter, are unable to pass

any of the ureteral constrictions and remain at the upper end of the ureter. The very large stones located in the lower ureter have probably passed from the kidney, become impacted, and increased in size

The location of the majority of stones in the lower ureter makes their manipulative removal possible in many cases, but several decided contraindications to such procedure have been emphasized by Braasch, who asserts that manipulations should not be attempted when stones are of a caliber greater than 2 cm, when they are impacted with considerable peri-ureteritis; when hydronephrosis or pyonephrosis with extensive destruction of renal function is a complication; when the stone is known to have existed for a long time; when several unsuccessful attempts have been made to remove it, when cystoscopic examination is borne poorly, especially in the male; when congenital anomalies and deformities of the genitalia exist; or when severe reaction or acute pyelonephritis attends the initial attempt at dislodgment, since the operation is extraperitoneal, the surgical risk is very small. Of the 640 surgical removals in our series there were but four (0.62 per cent) operative deaths

The technical methods employed in the removal of stones by manipulation vary with the operator. To Lewis must be given the credit as pioneer in this field, and his ingeniously devised ureteral dilator is still employed by many. For some years chemicals were thought to be of considerable aid, and various antispasmodics, especially papaverine, were very popular. Today urologists seem in agreement that the two essentials to success are the adequate dilation of the ureter and the shifting of the axis of the stone.

The first can be accomplished by the use of a dilator or by passing increasingly large catheters or sounds up the ureter past the stone, or by passing up several catheters at the same time. We prefer the latter method, since the stone on several occasions has lodged between the multiple catheters and been removed with their withdrawal. Usually such catheters are left in place for forty-eight hours; then each one is twisted separately and all are withdrawn together. Some stones will pass with the next

voiding, most will be recovered within the first two days and a few will pass after a week's interval. When the stone becomes impacted in the bladder wall its removal will be hastened by slitting the ureterovesical orifice. One of us has designed a pair of scissors for the purpose.⁷ Braasch, in an experimental study with animals, has shown that this does not result later in regurgitation up the ureter.

Age has little effect on the ease of recovery of the stone by cystoscopic procedures or the necessity for operation. In cases occurring before the age of twenty and after fifty, associated disease in the corresponding kidney is frequently found, and sometimes necessitates nephrectomy. Ureteral stones, like other urologic diseases, are more common in the male; 601 cases in this series were males, 279 in females. The majority occur in early and middle adult life: 78 per cent of patients were between twenty and fifty years.

AGE BY DECADES

Years	Cases.	Per cent
0 to 10	5	0.56
11 to 20	15	1.70
21 to 30	174	19.77
31 to 40	268	30.45
41 to 50	245	27.84
51 to 60	133	15.11
61 to 70	31	3.52
71 to 80	3	0.34
Not stated	6	0.68
Total	880	

OPERATIVE TREATMENT

Six hundred forty-eight operations were performed in 640 cases, eight cases being bilateral. The types of operations were as found on page 820.

Ureterolithotomy.—The incision for ureterolithotomy varies with the location of the stone. If it is in the upper third of the ureter, or if there is also an associated stone in the renal pelvis, a posterolateral incision is made. It is not necessary to extend the incision as far posteriorly as is usual in operations on the kidney. The upper third of the ureter and the ureterovesical

	Cases
Ureterolithotomy, extraperitoneal	522
Pelviolithotomy	12
Nephrectomy	33
Nephro-ureterectomy	48
Resection of one-half of horseshoe kidney	1
Exploration, stone not found (five found in bladder later)	13
Pelviolithotomy and ureterolithotomy	6
Nephrolithotomy and ureterolithotomy	2
Ureterectomy, partial (kidney removed previously)	3
Transperitoneal ureterolithotomy	1
Removal through vagina	1
Transvesical ureterolithotomy	6

angle may be readily exposed without delivering the kidney
In some cases the stone may be brought up into the pelvis and

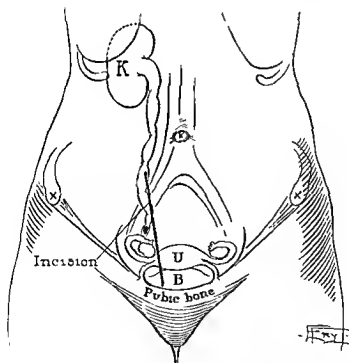


Fig. 344.—Rectus muscle splitting incision for exposure of lower ureter.
Incision extends to pubic bone

removed through a pelvic incision; this is especially desirable if
stone is also present in the kidney.

If the stone is in the iliac or the pelvic portion of the ureter, a straight rectus incision gives the best exposure. The exact location of the incision depends on the location of the stone. If the stone is in the lower segment, the incision through the rectus muscle should be made directly down to the pubic bone

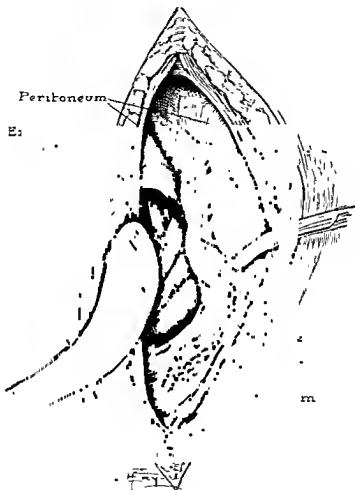


Fig 345 —Ureter adherent to posterior surface of peritoneum which is retracted toward the middle line.

and should be of ample length (Fig 344). The peritoneum is pushed toward the median line until the iliac vessels are uncovered. If not fixed by inflammatory or postoperative adhesions to the surrounding tissues, the ureter generally follows the retracted peritoneum and is found on its posterior surface (Fig

345). In cases in which the ureter is dilated it may be readily located. In other cases the palpation of the stone may determine the position of the ureter. When the stone is once found it is usually advisable to hold it between the thumb and forefinger until the ureter is incised over it and the stone removed. It must be remembered that ureteral stones are occasionally freely movable and may easily slip either up or down the ureter. On this account it is always well to have a roentgenographic examination of the ureter just before operation. The ureter is incised longitudinally. If there is no obstruction in the lower ureter the incision readily closes and rarely results in a urinary fistula. If possible it is desirable to close the incision in the ureter with several interrupted stitches of fine catgut. After the removal of a ureteral stone the ureter should be explored for a second stone and the stone removed should be compared with the roentgenographic shadow. Occasionally the presence of a second stone may have been obscured by the shadow of the stone removed, or the two stones may have been faceted so as to simulate a single stone. In some cases small fragments may be broken off, particularly if the stone is large and impacted at the bladder wall.

In the case of stones impacted in the bladder wall it may be necessary to open the bladder and carry out a combined trans-vesical uterolithotomy. This was successfully performed in a number of cases. The bladder is completely closed after removal of the stone, unless the urethra or the vesical neck is obstructed. Judd described a method of exposing the lower ureter by means of elevating the bladder and lower ureteral segments. This is done in the same manner as when the bladder is exposed preliminary to resecting a portion of it for malignant disease, and has been satisfactorily employed for stones in the lower 2 cm. of the ureter. A median line suprapubic incision is made for this exposure.

The method sometimes employed of diagnosing ureteral stones by means of a lead ureteral catheter is unreliable, because extra-ureteral shadows, such as phleboliths, may fall in line with the catheter and be mistaken for stones (Fig. 346). A ureter-

ogram should always be made. The injected solution will be seen to surround the stone, and dilation of the ureter above it will usually be evident, or if the shadow is not a stone a portion of it will lie outside the ureterogram (Fig. 347).

Nephrectomy and nephro-ureterectomy.—The kidney was removed in eighty-one (11.09 per cent of 640) cases. In forty-eight cases the ureter was also removed, in most instances completely. In most of these the kidney had been partially or com-



Fig. 346.—Shadow in line with lead catheter, giving impression of being a stone in the ureter.

pletely destroyed as a result of ureteral obstruction. In a few cases there were also stones in the kidney.

In most of the cases in which nephrectomy or nephro-ureterectomy was carried out, the kidney was exposed through a posterolateral incision. If the stone could then be reached, the kidney and segment of ureter were removed. If the stone was in the middle or lower third and the ureter dilated and the stone impacted, the vascular pedicle was cut and ligated and the kidney

left hanging from the anterior angle of the wound (Fig. 348). The patient was then turned over and an anterior rectus incision made, through which the ureter was isolated and cut below the stone. The ureter was freed as far as the point reached from the posterior incision and then drawn through the posterior wound while still attached to the kidney. It is usually desirable to leave a long strand of catgut or silk fastened to the retreating ureter so that the lower end of the ureter may be recovered,



Fig. 347 —Same shadow as in Fig 346, demonstrated to be outside of ureter by ureterogram

if it does not readily pass through into the area of the posterior incision

Simple dilatation of the ureter does not mean that the kidney is functionless or that the ureter will cause trouble later. In a number of cases in which the ureter was 2 or 3 cm. in diameter at the time a simple ureterolithotomy was performed, no further trouble was experienced, and the patients were perfectly well from three to six years later

Stone in the remaining ureter.—Not infrequently small stones are left in the ureter after nephrectomy. If associated with minimal infection they usually cause no trouble, but if the ureter is dilated and septic it may serve as a focus of infection and either cause a persistent sinus or produce an intermittent

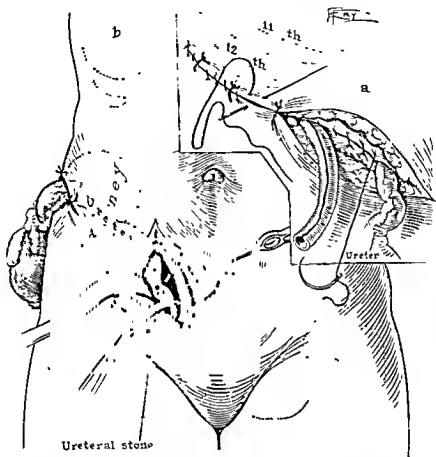


Fig. 348.—(a) Closure of posterolateral incision with ureter hanging from anterior angle. (b) Isolation of lower ureter through anterior incision.

or continuous cystitis. In rare cases the remaining stump of ureter may retain enough contractile tissue to cause rhythmic spurts of highly infected material into the bladder. There were three cases in this series in which a stone was removed from the ureter after nephrectomy. One patient, a woman, aged thirty-seven, had a subcapsular nephrectomy for pyonephrosis. One

year later the wound was still draining slightly. At a second operation the ureter was found to be markedly distended, contained a stone, and communicated with an abscess pocket in the region of the stone, 7 cm. of the ureter were removed and the abscess pocket drained. Three years later the patient was well.

The second case was that of a woman aged thirty-two. Seven years before she had had a left nephrectomy performed for calculous pyonephrosis. For the last three years she had suffered from frequency and dysuria, with an occasional attack of hematuria. At operation a stone, 1 cm. in diameter, was found and removed from the left ureterovesical juncture. The ureter was of normal size and there was no peri-ureteritis. She recovered readily from the operation and has had no trouble since then.

The third case was that of a woman, aged twenty-nine, who had had a right nephrectomy performed two years before coming to the Clinic. Her wound had never closed and was discharging continuously. At operation a stone, 1 cm. in diameter, was found in the middle third of the ureter, and there was a mild peri-ureteritis. Eighteen centimeters of ureter containing the stone was removed. Four years later the patient was well.

POSTOPERATIVE RESULTS

A number of the large series of operations for ureteral stones found in the literature comprise those performed during the period of the evolution of renal and ureteral surgery, and consequently show a high operative mortality. Jeanbrau reported sixteen (13 per cent) deaths in 122 ureterolithotomies. There were five deaths in sixty-four extraperitoneal ureterolithotomies. Excluding six cases of complete anuria there were ten (8.6 per cent) deaths in 116 cases. Israel reported two (3.7 per cent) deaths in fifty-three cases. Israel's patients were more recently treated than those reported by Jeanbrau and most of the operations were extraperitoneal.

In the 640 cases in the present series there were four (0.62 per cent) operative deaths. There were no deaths following

uncomplicated ureterolithotomies. In the four cases in which death occurred, either other surgical procedures were also carried out or other disease of the urinary tract was partly responsible for the death.

Of the 640 cases 455 have been heard from on an average of from three to four years after operation. In sixty-eight cases there has been a persistence of discomfort similar to that present before operation. In some of these the discomfort is only slight. Stones have been passed by forty-six patients since operation.

This recurrence in approximately 10 per cent is the same as was reported by Braasch and Foulds in a series of 819 patients operated on for nephrolithiasis.

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THE DIAGNOSIS AND TREATMENT OF THE MORE COMMON DISEASES OF THE ANUS, RECTUM, AND SIGMOID

LOUIS A. BUIE

When a patient consults a physician it is customary and proper for the physician to listen carefully to the description of the symptoms and to follow such taking of the history by a careful examination. For this purpose all useful methods and implements are employed. Of the latter, the ophthalmoscope, aural and nasal speculums, tongue depressors, bronchoscopes, esophagoscopes, gastroscopes, and stethoscopes may be mentioned. If the patient complains of a gastric disorder roentgenograms are obtained. This tendency toward intensified investigation is universal except in the realm of rectal diseases. When the patient complains of diarrhea, pain, melena, or any such departure from the normal, instead of examining the stools, looking into the bowel, obtaining a roentgenogram, or even making a digital examination, there is a tendency to treat his symptoms with bismuth, sedative suppositories, purgatives, or salves. In other words, the idea of examining the rectum is distasteful to physicians, and they know, moreover, that the patient will be better satisfied, temporarily, if he is allowed to go without having to endure this ordeal. This is particularly true in cases in which patients are well known, or possibly close friends of the physician. There is a peculiar but ever-present antipathy felt equally by patient and doctor under such circumstances.

It is inconsistent for physicians to broadcast their ideas and issue propaganda against cancer, from pulpit and press, if they are going to allow direct evidence, such as is furnished by the history of patients, to go unprobed. It is unfortunately true that patients with rectal disorders wait for an emergency before they seek medical aid. It is especially true of rectal diseases,

therefore, that the understanding of the true significance of symptoms demands deep delving

Rectal symptoms are unreliable in determining a diagnosis: Patients with impending obstruction often have frequent stools; many sufferers from endamebiasis and even chronic ulcerative colitis are constipated. It is not sufficient to treat symptoms; thorough examination must be carried out, especially since it is not difficult. Expertness is not needed to examine the rectum, any physician can insert a proctoscope and inspect 10 or 12.5 cm of the lower bowel. Neither is it necessary to become accurate in the differential diagnosis of all rectal lesions. If the diseased mucosa can be distinguished from the normal, and malignant tissue from benign, that is sufficient. If, in the presence of melena, the possibility of a high-lying carcinoma could be ruled out before operating for hemorrhoids, a distinct advance would be gained over the usual practice in the past. In a recent review of the records of 1,937 patients with cancer of the rectum or sigmoid (in the Clinic from 1912 to 1922), I found that one out of every five had been treated elsewhere in some fashion for hemorrhoids during the period of their symptoms

EXAMINATION

If the patient is not very ill it is best to prepare him the night before. A dose of castor oil is given, and no supper is allowed. About an hour before the examination the patient is directed to irrigate the bowel with warm water and soapsuds until the water returns clear. If the patient is ill or obstruction is suspected, enemas will suffice and they will do no harm.

The position of the patient is important, improper preparation and an unsuitable position can render an examination unsatisfactory and often impossible. The knee-chest or the Sims position will suffice, but it is often necessary under such circumstances to balloon the bowel by forcing air into it. This causes unnecessary and sometimes severe pain, and interferes with the patient's ability to cooperate, which is essential to a successful examination. The inverted position can easily be obtained by using a table especially constructed for the purpose.

or by having the patient rest with his legs across a bed and with his elbows on a pillow on the floor (Fig 349). In this position the abdominal viscera hang down away from the pelvis so that as soon as a proctoscope is inserted there is an inrush of air which balloons out the rectum and renders an examination very easy. Proper lubrication and care are essential in introducing the proctoscope, and it is well always to examine digitally first. If the patient has a fissure or other painful lesion of the anus,



Fig. 349 —The inverted position. Obtained satisfactorily by using a bed. Special tables are constructed for this purpose by Scanlan Morris Company.

swabbing it with 10 per cent cocain will make the examination painless

The instruments used are a matter of personal choice. There are many varieties of equipment, including anoscope, and proctoscope with battery and lights which have proved very satisfactory (Fig. 350). With the first maneuver the proctoscope is passed through the anus and the obturator withdrawn; the remainder of the examination is carried out under the direct vision of the examiner. As the instrument approaches the sacrum care should be taken to avoid striking the mucosa. Dangerous

trauma may result when the bowel wall is caught between the metallic edge of the proctoscope and the hard surface of the sacrum. If the sigmoid is to be inspected the barrel of the instrument should be pressed anteriorly, forcing the anterior rectal wall forward until the lumen into the sigmoid is visibly open; then the proctoscope enters the sigmoid without difficulty. Sometimes air is necessary for this last manipulation and the patient must not be permitted to strain or grunt. The entire

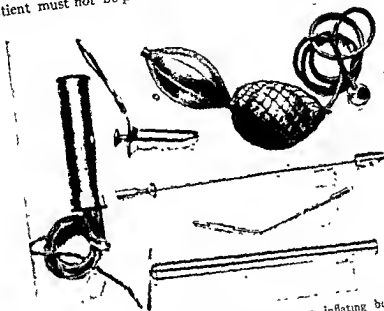


Fig 350 —A portable outfit anoscope, proctoscope, inflating bulb, and battery with connecting cord.

procedure of proctoscopy and sigmoidoscopy in a normal person does not require more than one or two minutes if the physician is accustomed to the task. The anus is easily examined when the proctoscope is being withdrawn, but if greater accuracy is necessary an anoscope is preferable.

The normal color of the bowel varies from a pale pink to the dark brown of melanosis, a symptomless condition so far as its own pathologic potentialities are concerned, and seen only in constipated patients, though not an invariable accompaniment

of constipation. I am quite sure that there are numberless instances of earnest practitioners subjecting their patients to intensive rectal treatment when the bowel is perfectly normal and the only complaint is constipation with possibly the passing of mucus. It is well to realize that fully 90 per cent of all rectal complaints can be accounted for by findings demonstrable in the last 7.5 cm. of the rectum

COMMON DISEASES

Anal fissure.—All cracks around the anal margin are not true fissures, and a little cleanliness will suffice to heal most of them unless they occur at the posterior anal commissure. It is unwise to apply caustics to every little crack in the anus, and very often small abrasions, which might quickly get well if kept clean, are converted into anal fissures by cauterizing. Physicians are too prone to "touch them up." A true fissure is a varicose ulcer, and 90 per cent of them will be found in the posterior anal canal. Since there is a large amount of varicosity around the anus, a chronic anal ulcer should be treated like a varicose ulcer anywhere. A fissure usually appears as a break in the skin of the anus, with infected and often granulating borders. There is usually a pocketing under the skin margin frequently forming the so-called sentinel pile. The inner extremity extends up to the dentate margin and usually a hypertrophied papilla is present. The sentinel pile and the hypertrophied papilla are fairly constant accompaniments of anal fissure; the recurrences after operation are usually due to the fact that they have not been removed. The proper treatment for a fissure is its surgical removal. The preoperative preparation is the same as before proctoscopic examination. Sacral anesthesia is very satisfactory. The anus is dilated gently and just enough to overcome the muscle contraction. Divulsion is unnecessary and results are less satisfactory when it is used. Superficial cracks, edema, thrombosis, and contusions follow such violent handling, and a prolonged period of uncomfortable convalescence results. It is supposed to cure the fissure by putting the anus at rest, but the tone of the muscles is soon restored and the effect lost. It would

scarcely be expected that a varicose ulcer on the leg would respond well to such treatment

After dilating the anus gently, the hypertrophied papilla or the inner margin of the fissure is exposed, and the entire lesion, including the sentinel pile, excised down to the sphincter fibers. Enough of the skin margin is taken out to prevent pocketing as healing takes place. If there is much anal spasm or contraction, the anus can be put at rest by cutting across about half the fibers of the external sphincter. It may be necessary to tie a small vessel or two, but usually no sutures are necessary at the margin. If the hypertrophied papilla is large, the mucosa above it should be ligated. After the insertion of a small wick of iodoform gauze the operation is complete. The patient should remain in bed for two or three days on a liquid diet and no bowel movement allowed. No opium is necessary to "confine the bowels." The average patient can manage this himself. A dose of mineral oil and a general diet will start the daily bowel habit, and then the most important part of the treatment is begun. After every stool the rectum should be irrigated with hot water (110° F.) until the water is clear. This is followed by careful drying and the insertion into the anus of a piece of cotton saturated with witch hazel. The patient should preferably report daily, after the bowels have moved, to have the anal canal irrigated with witch hazel or some other mild antiseptic solution and the wound margins carefully cleaned. If it is realized that surgical wounds around the anus demand the same care as surgical wounds in other regions, the fissure will be well after a week, or possibly two weeks, of painless convalescence, and it will not recur.

Rectal pain is not a "simple" matter and a fissure is probably the most painful of anal or rectal lesions. The importance of these conditions should not be minimized. Office methods frequently prolong trouble, and ultimately after several office "cures," the patient comes to the radical and proper treatment before he obtains relief. The tendency to temporize and delay proper investigations is partly responsible for the so-called quack institutions. Quack or not, the efficiency of some of these

institutions is surprising. Many of them are managed by graduate doctors of medicine who do accurate and scientific work. There are some that carry on a vicious and dangerous business, and it is these "outfits" which should be suppressed. They will never be disturbed, however, until regular physicians examine and treat their patients properly. We should stop crying out against the quack pile specialists, chiropractors, and other types of harmful specialist and begin to set our own house in order. Many, and I believe most, of the patients who consult the quack do so after they have consulted the regular physician.

Papillæ and crypts.—It will be necessary to describe the papillæ and crypts of the anal canal before going on to discuss

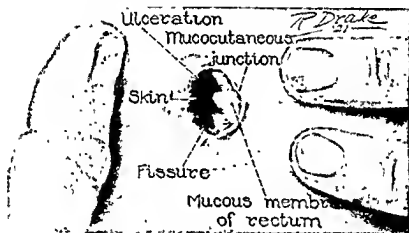


Fig. 351.—This operator had difficulty locating the "free margin of the skin" referred to by Whitehead, hence the unsatisfactory result.

lesions of them. The necessity is not surprising, in view of the inadequacy of the teaching of proctology in colleges. Many of them do not require examinations in this subject and there are none, I believe, in which a course exceeding two to three hours a week for three months is given. The lack of knowledge of the appearance of the normal anus and rectum is responsible for most of the unsatisfactory surgical results in this region. Few textbooks give an adequate description of anorectal structure and no two of them agree on the anatomy. The mucocutaneous juncture is apparently an indefinite line which exists somewhere

around the anal orifice, and no better illustration of the confusion regarding its location can be offered than the variety of points to which the mucous membrane of the rectum has been sutured in the many patients whom we see returning with troublesome symptoms following Whitehead operations (Fig 351)

This mucocutaneous juncture is actually an irregular serrated line about 2 cm above the anal orifice. The distance from the outlet is variable, and in some persons it is less than 1 cm. It represents the line of union of the hind gut with the proctodeum in the embryo. The nerve, blood, and lymph structures are entirely different above and below this line. Pain sense is very acute in that part of the anal canal below this dentate margin, but above it pain sense is entirely absent. Lymph drainage below it goes into the inguinal glands and above it into the sacral and hypogastric nodes. Often an enlarged gland will appear in the groin of a patient suffering from an anal fissure. Occasionally such a gland suppurates and the patient is treated for bubo. In one such case the patient complained finally of anal pain and a fissure was excised, after which the "bubo" healed rapidly. The blood supply above and below the juncture are differentiated with equal definiteness, the chief point of difference being that the veins from above it go to the portal circulation and those below it to the vena cava.

The papillæ of Morgagni are the little projections of skin on the margins of this dentate line. They exist normally, and it is only when they become enlarged, inflamed, or diseased in some way that they require attention. The difficulties here are those that attend the handling of relatively unfamiliar subjects. Certain surgeons make it a practice to remove all papillæ, on the assumption that they are responsible for numerous grotesque and remote symptoms, and others do not know enough concerning their structure to recognize them. Years ago "rectal specialists" used to treat anal pockets and papillæ in all who made no objection. When a person suffers from so-called mucous colitis, with its accompanying constipation, indefinite abdominal discomforts and general nervousness, weakness, and so forth, it is a very simple matter to treat him along any line, and it was with

just this type of patient that the "itinerants" of old did their work. Such practice is still being done, and it is not limited entirely to the itinerants

The crypts of Morgagni are little pockets below the dentate margin formed where the mucous membrane and the skin unite. They vary in depth from mere depressions to pockets as much as a centimeter in depth, and sometimes sinuses of varying depth are found. This has a very important relation to fistula in ano, and will be further discussed.

The papillæ and crypts become the seat of numerous pathologic processes. Cryptitis, papillitis, and hypertrophied papillæ are met with daily by proctologists. Enlarged papillæ are frequently called polypi erroneously. An anal polyp is rarely seen. All hypertrophied papillæ do not require removal, but when they produce pain, burning, a sense of incomplete evacuation, or prolapse they should be excised. They should not be burned out, chiefly because of the amount of residual pain that follows any burning operation involving the skin below the dentate margin. A more serious objection, however, is the formation of broad irregular scars which distort and often constrict the anal lumen. Infected crypts are usually easily discernible by the reddened and somewhat macerated appearance of the surrounding tissue and the tendency toward oozing of blood. However, a blind sinus often exists at the inner extremity of an apparently healthy crypt which when opened with a probe will exude pus. These often require opening and if there is an enlarged papillæ below it, this should be removed. Most cases of cryptitis, however, can be treated by hot irrigations and topical applications through the anoscope.

Fistula in ano.—All physicians are familiar with the different types of fistulas and the difficulties of eradicating some of them; but most physicians have an incorrect opinion of their cause and the location of the internal opening. Usually fistulas originate in the anal crypts and result from an infectious process beginning in them. The opening of the crypt is closed by edema or plugging, and the infection goes on to abscess formation, which in turn usually burrows between the internal and external

muscles and thence into the loose tissues around the ischio-rectal fossa or up alongside the rectal wall. Most fistulas, therefore, are due to simple infections of the anal crypts, and not to tuberculosis, as has been generally taught. In fact, I believe that only 10 to 15 per cent of anal fistulas are tuberculous. It is a very rare experience to find the internal opening above the dentate margin. The tract may open externally and also extend far up along the bowel wall, but the internal opening is in the crypt between the anal muscles, and it will usually be found that the sinus originating in the crypt has burrowed in both directions. The fact is that fistulas probably never have their internal opening in the rectal wall (above the dentate margin) unless the abscess process has involved the bowel wall secondarily and broken through. Even then the original internal opening and starting point are in the crypts.

This is a most important consideration when attempting to remove these tracts because one feature which annoys most surgeons in attacking fistulas is the fear of producing incontinence. It is seldom necessary to cut more than the external sphincter muscle. Those who cut both muscles often do so unnecessarily and fail to get the internal opening. In order to remove fistulas, any method may be used to follow the tract, such as the injection of methylene-blue or barium or the insertion of silver wire. While excising the tract, the internal opening is sought by probing the tract toward the median anal canal. When this opening has been excised, simply curetting and packing that part of the tract which has burrowed along the bowel wall, to make it heal from the bottom out, will produce a cure.

Hemorrhoids.—There are two chief varieties of hemorrhoids, internal and external, and there is a combination of the two known as interno-external or externo-internal hemorrhoids. Thrombosed, edematous, strangulated, bleeding, and ulcerated hemorrhoids are merely things which can happen to the external and internal hemorrhoids. This subject may be dismissed with a few suggestions as to their treatment. If a thrombosed hemorrhoid is small and not very painful it will require no treatment, if large and painful or ulcerated it should be excised. Sutures

are seldom necessary. Edematous or strangulated and infected hemorrhoids should be first eased by hot wet dressings frequently applied until the acute symptoms subside. It is surprising, however, that many physicians are unable to distinguish the different types on examination. I know of instances in which attempts have been made to "reduce" edematous external hemorrhoids by forcing them up into the rectum. In one case the zealous physician had succeeded in forcing several large edematous and thrombosed external hemorrhoids into the rectum and maintaining them in that position with a large ball of cotton under an adhesive strap. Here again difficulties thrive on unfamiliarity with structures. The sole difference between the two types of hemorrhoids is that the internal, being above the dentate margin, are covered by mucous membrane, while the external are covered by skin. It makes no difference how far externally the internal hemorrhoids protrude, they are still internal hemorrhoids if covered by mucous membrane, a fact which has an important bearing on their treatment. Burning operations should not be employed with external hemorrhoids. When the two types are combined and it is desired to perform a clamp and cautery operation, the marginal or external veins should be dissected up above the dentate margin before the clamp and cautery are applied. It is usually unnecessary to suture the skin margin, and it is desirable to avoid it when possible. When the ligature operation is performed the margins external to the dentate line can be left unsutured in most cases. Suturing the skin sometimes causes abscess pockets to fill in from the inside, or a delay in the separation of the sutures increases infection and prolongs the postoperative period.

A great many legitimate physicians are now employing various kinds of injection treatments for hemorrhoids, but they are not applicable to all types of the disease. Many noted English surgeons have used injection treatments for years. They use the phenol and glycerine combination, but none, I believe, has used these injections for marginal or external hemorrhoids. Most reports of these treatments have been favorable and I see no reason why they should be avoided. There has been a

tendency in this country to cry out against injection treatments, electricity, and the various types of "painless pile remedies," chiefly because they have been employed by the advertising specialists. We should not blind our eyes to methods which have proved themselves effective just because they appear to be used largely by those considered unethical. It is possible that these methods when used indiscriminately may result seriously, but any good method may cause havoc in incompetent hands. It behooves us to take care of our patients, and if they prefer the "painless pile injections" and the hemorrhoids are of a suitable type, we should use that method. If we do not, the patient will answer one of the ubiquitous newspaper advertisements and get it elsewhere. Then he may fall into the hands of one who does not use a proctoscope and makes it a practice to treat the piles whether there is a malignant disease present or not.

As for the numerous methods employed in the surgical removal of hemorrhoids, suffice it to say that any operation will produce satisfactory results if done properly, provided proper care is taken of the wound.

It is of practical value, however, to know a satisfactory injection treatment, and one originally described by Terrel in 1914 should be useful. It is not to be expected that this method can be mastered by merely reading so meager a description as this, but the difficulties and complications can be learned by watching those who are using it successfully.

Cases should be carefully selected, since this form of treatment cannot be applied to all types of hemorrhoids. As a general rule, medium-sized, internal hemorrhoids respond best. Excessive bleeding can be stopped immediately. External hemorrhoids cannot be treated in this way, and, of course, if edematous, thrombosed or acute, they should never be injected. When patients have systemic diseases which contraindicate more extensive operations, the injection method is very useful; 1 or 2 c.c. of a 5 per cent solution of quinin and urea are injected directly into the hemorrhoid with a small needle and a Leur syringe, after first withdrawing the barrel of the syringe slightly in order to avoid injecting the solution directly into the

blood stream. Superficial injections often result in a slough, and when the solution is injected too deeply no effect will be produced. The cure is brought about by a mild inflammatory reaction and ultimate fibrosis around the venous spaces which contracts the varicosity and excludes the blood. Sloughing may accomplish the same ultimate result, but it is undesirable and will occasionally be responsible for hemorrhage of alarming proportions. We all realize that much bleeding can occur within the rectum before there is any warning. Each hemorrhoid should be injected once, taking one every other day; and after a week the injections can be repeated if thought necessary. In most instances one injection is enough. The usual care about mineral oil and diet, to avoid the passage of hard stools and the necessity of straining, should be observed. The progress of the treatment is observed through the anoscope and proctoscope. None of these methods should be attempted unless it is to be followed up and given proper postoperative attention.

It is not necessary for general practitioners to become expert in all the specialties, but it is desirable that they should be aware of the pitfalls which result from ignorance or wilful neglect. They do not have to know all there is to know about proctology, but they should know enough to protect patients and to understand when the demand exceeds their ability. Thus, at least, patients can be insured against the accidents and untold difficulties that are being thrust on them by incompetent practitioners.

Stricture.—Malignant and benign strictures are the two types involving the rectum. A study of the literature of benign strictures of the rectum shows most clearly the tendency to accept explanations of conditions because they are written in textbooks. Long ago the textbooks classified a rectal stricture as either cancerous or syphilitic, and the error has persisted. I have seldom seen a rectal stricture show the slightest tendency toward favorable response under the influence of syphilitic treatment. Actually the only result of the employment of this mode of treatment is to delay other measures which might be

helpful. The only other excuse for giving this treatment would be the assumption that the stricture is diagnostic of systemic syphilis. This idea is unsound, especially since there are other more accurate diagnostic methods. Ever since I can remember, it seems to me, we have accepted as a sort of inevitable sequence the situation of syphilitic treatment following the discovery of a rectal stricture, and it is time that we discontinued such valueless empiricism. There is no particular connection or relationship between syphilis and rectal strictures; syphilis is responsible for less than 15 per cent of such lesions.

Figures based on a study of 258 cases observed in the Mayo Clinic showed that trauma and infection were responsible for most rectal strictures. The type of trauma includes operations (on fistulas, hemorrhoids, and so forth), burns, scalding enemas, infections, and ulcerations. The type of ulceration associated with chronic ulcerative colitis almost always causes a contracted bowel. Endamebiasis rarely, and tuberculosis practically never, causes contraction. In thirty-two patients only was there evidence which pointed to syphilis being a possible cause. A somewhat higher percentage would be expected in a city clinic. Sanders, in a recent report of cases occurring in his clinic in Memphis, found only a slightly higher incidence, and a number of his patients were negroes.

The treatment depends almost entirely on the degree of involvement of the rectal wall and the amount of contraction and ulceration. If there is a small ring stricture with only slight ulceration below the peritoneal reflection and the contraction is sufficient to be obstructive, an internal proctotomy, made by cutting the stricture posteriorly, and careful postoperative treatment with dilatations and hot enemas will usually effect a cure. Breaking the stricture by forcible dilatation is unwise because it entails the probability of breaking through the bowel wall anteriorly. If the stricture is above the peritoneal reflection, it is best to avoid any attempt at correction from below. If lubrication does not enable the feces to pass the constriction, or if interference is imperative, a resection and tube anastomosis should be performed by the abdominal route. Such an opera-

tion can be performed only when the entire stricture is high, and is a good method of attack in all strictures above the rectosigmoid. When they occur high enough, a Mikulicz type of operation can be performed. However, strictures in the high rectum and sigmoid are not common.

If tube strictures involve the rectum and do not contract the lumen too much, it is best to treat them palliatively. If the lumen is not less than 2 cm. in diameter, patients should be urged to avoid operative or other types of dilatations. Some can get along comfortably with even less lumen. In such cases there is always ulceration and a discharge of pus and blood which are responsible for the patient's chief difficulties. The discharge causes frequent desire to defecate and the passage of the stool produces soreness and an inflamed anal margin. It is, therefore, possible to accomplish much for the patient's comfort by teaching him how to care for himself daily and by using topical applications of such agents as argyrol 20 per cent, chinosol 2 per cent in sodium chlorid, dichloramine T, mercurochrome, silver nitrate in increasing strength, beginning at 2 per cent and going up to 20 per cent, and even lunar caustic. He should prepare himself each day by using hot rectal irrigations.

When the strictures are long and the lumen is constricted enough to produce a marked obstructive syndrome, we do most good by advising a permanent colostomy, and in that event the patient will be much better if the rectum is resected at a second operation. A great deal may be accomplished by persuasion in cases in which colostomy is advisable. A colostomy is certainly undesirable when considered by one who is healthy and does not need one, but when it is being exchanged for an unbearable existence or death, as is true in cases of malignancy, the prospect loses much of its distastefulness. Moreover, a patient can be made comfortable if the colostomy is properly cared for by a cleansing irrigation twice daily, thorough padding, and the use of an abdominal support instead of the impossible and offensive colostomy cups. Patients under such circumstances can go about their daily activities. Contrast the condition of such a patient, relatively strong and happy, with the fallow, drawn,

emaciated, and worn-out invalid devoting all his efforts and money to getting treatment and spending most of his time in pain and in the toilet. All of these phases of the situation should be carefully explained to the patient. A little eloquence in such cases is much better than a lot of medicine.

Proctitis.—The color of the normal rectal mucous membrane is pink, a rather pale pink, with a fine network of blood-vessels showing through the superficial cellular layers. Variations of this picture will be seen in the normal mucosa. The melanosis previously referred to is not pathologic. A mucosa may be dry or it may appear to glisten excessively with secretion and yet not require treatment. These facts are worth mentioning, because many patients are subjected to prolonged and excessive treatment for conditions for which the supposed rectal diseases could never be responsible. Atrophic and hypertrophic proctitis are conditions which possibly do exist, but it is probable that their significance is greatly exaggerated. It is possible to get into a bad rut in rectal therapy. The same overenthusiasm that dictates the removal of every slightly hypertrophied papilla is responsible for the attempt to remedy irregular and bizarre symptoms, usually in constipated and neurotic persons, by administering "treatments" for some peculiar form of mild proctitis which appears to be disguised by a dry and pale mucous membrane suspiciously similar to the normal. This is especially true in cases of so-called mucous colitis. Such patients demand treatment of some kind. They have spent most of their lives and incomes under the care of first one physician and then another, and the probabilities are that they will devote the remainder of their lives to the same cause. They are nervous, constipated, and pass large quantities of mucus which often relieves the crampy abdominal pains. All such patients are familiar with medical terminology and the latest articles in medical periodicals. They are tired and worn out and "everybody thinks there is nothing wrong." There are somewhat more than 25,000 varieties of patent laxative medicines in existence, and these patients have done more than their share to support the industry. They must have treatment, and if we do not give it, or even if we do, they will seek advice elsewhere eventually.

I have been unable to discover any pathologic changes in the mucosa of the lower bowel in mucous colitis. It is because the rectum is the nearest portal of entry to the source of all this mucus that it is so promptly and frequently attacked. The treatment would far better be directed toward the correction of the accompanying neurasthenia and constipation than toward the cure of hypothetic disease in the 12 or 15 inches at the end of about 30 feet of intestine

Proctitis varies from a mild inflammatory reaction to the most intense and destructive ulcerative process. Some of the milder types may be simple and transitory affections of the mucous membrane, or they may really be an early phase of a condition which progresses to the most extensive and hopeless disease. When examining the bowel the question of the presence of inflammation can be decided by rubbing it gently with a swab of cotton. Even a slightly inflamed membrane will nearly always exude a little bloody serum under such circumstances. Gently swabbing a normal bowel will never produce hemorrhage. Most types of benign ulceration have an associated inflammatory reaction in the adjacent mucosa, and are thereby differentiated from malignant disease. Chancres and tuberculosis, so elaborately described in various textbooks, are rarely seen in the rectum. Gumma is also very rare, and gonorrheal proctitis is the least common of all types.

Infections beginning around the anal crypts or secondary to rupture of abscesses and discharge of pus into the bowel, extensions of infections from sloughs following rectal and anal operations carelessly followed up, faulty treatment and manipulations, and the various organisms of dysentery are the usual causes of proctitis and rectal ulceration.

Endamebiasis will occasionally invade the rectum. The ulcers are discrete, oval, punched out, and vary in size from 0.5 to 2 cm. Most of them are small. The mucosa between them is not affected except in extensive cases in which the reaction is probably due to secondary infection. The bases of the ulcers will be found to contain numberless *Entamoeba histolytica*. The emetin or the ipecac treatment, combined with coal-oil

enemas, will heal the ulcers in two or three weeks. Recurrence, of course, often occurs, but a second or third course of such treatment will usually produce a cure.

Bacillary dysentery produces a diffuse hyperemic proctitis which disappears under the usual treatment for this condition, combined with warm cleasing enemas.

Proctitis and ulceration, associated with chronic ulcerative colitis, presents a very difficult problem. The proctoscopic appearance is characteristic in several ways. The bowel wall

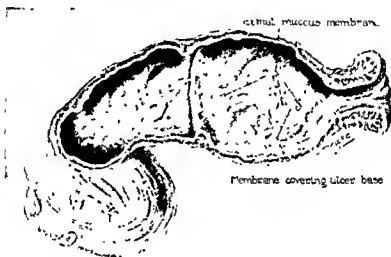


Fig. 352 —Early stage of chronic ulcerative colitis

is always granular or glazed in appearance. This is one of the earliest manifestations, and even after years of progress, until the contracted bowel shows large irregular ulcers on scar bases, this granular appearance can be seen in patches between them. These granular pits are due to two phases of an ulcerative process. At first the mucosa becomes inflamed and edematous and breaks down into myriads of little follicular ulcers about 1 mm. in depth and 2 mm. in diameter (Fig. 352). When seen in this stage through the proctoscope they appear as numerous yellow,

pussy spots on the reddened and swollen mucosa. After a cotton swab has been rubbed gently over this surface, the pus is replaced by blood which comes from the bases of these ulcers. There is a decided tendency in this disease not only toward healing even without treatment, but toward recurrence of the lesions, especially after acute attacks of tonsillitis, colds, and such infections. Sometimes, however, there is no apparent cause for the reactivation. This process of repeated healing after recurrence results in scarring, thickening, and contraction

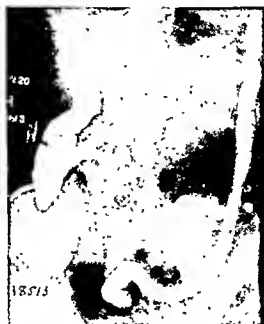


Fig. 353 —Colon ray, after barium enema in an advanced case of chronic ulcerative colitis. Multiple polypi also present, shown by mottling

of the bowel wall which has a characteristic appearance that can be easily detected through the proctoscope. Roentgenograms of the colon taken after barium enema show characteristic deformity when the lesions extend above the rectum. In the early and more acute stages there is a "feathering" of the bowel outline, due probably to irritation and spasm. After the disease has progressed to scarring, the roentgenogram will reveal clearly the obliterated haustra and tube-like contracted bowel (Fig. 353). It is necessary to take roentgenograms of the colon in all

these cases because the treatment depends largely on the amount of bowel involved, and if the lesions extend beyond the sigmoid, this is our only means of determining their upper limit. Small ulcerated polyps will often be found scattered about the bowel wall and occasionally the scar of old healed ulcers will contract around relatively normal areas of mucous membrane, giving the appearance of polyposis (Fig. 354)

As a general rule, the higher the involvement extends, the the more serious the condition of the patient and the more heroic the measures necessary to give relief. If the ulceration is

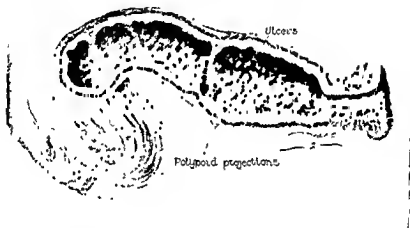


Fig. 354.—Appearance of multiple polyposis due to contraction of scars around relatively normal mucosa. Note thickened and contracted bowel wall.

limited to the rectum alone, treatment through the proctoscope will usually heal the lesions, although sometimes it requires weeks or even months of active effort. Even when the sigmoid is affected, a desirable response is often obtained by irrigations and local applications to the bowel wall. When the disease extends above the sigmoid, however, proctoscopic treatment is disappointing.

It is usually best to combine general treatment with local. Ulcerative colitis practically always begins in the rectum and extends up into the bowel, involving the entire colon in many

cases. In this respect it is directly opposed to tuberculous colitis which, beginning in the cecum, extends toward the rectum but rarely involves it. Often after the primary ulcerative colitis

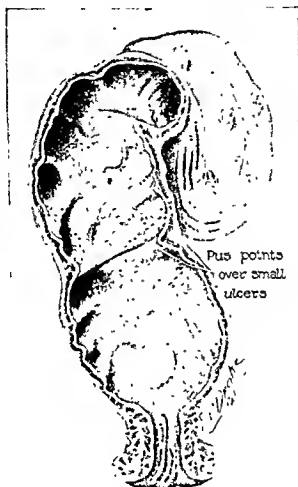


Fig. 355—Usual appearance of residue ulceration after primary process has cleared. The "normal" or healed mucosa shows the pitted scars of the original disease.

has been cured throughout the colon, there will be a residue of secondary ulceration in the rectum which can be healed only by local treatment (Fig. 355).

There is no fixed course of general or systemic treatment.

The most popular remedies now used are tincture of iodine and kaolin by mouth, and a diet high in protein and low in residue. Sometimes the emetin or ipecac treatment for endamebiasis is also used, especially when the appearance of the bowel lesions is slightly atypical. Logan has observed remarkable and apparently spontaneous cures after the iodine treatment. Numerous efforts have been made to treat this malady with vaccines made from organisms obtained from the rectal lesions, but thus far little progress has been made.

Along with the systemic treatment hot cleansing enemas are given daily, followed by the injection of 60 to 80 c.c. of witch hazel or chinosol, or an ounce of 20 per cent argyrol. Other mild antiseptic solutions would probably answer the purpose just as well. In the evening three teaspoonfuls of bismuth subnitrate, suspended in an ounce of olive oil, are injected for retention during the night. It is also often necessary to swab the lesions with silver nitrate in varying strengths up to 20 per cent, but the stronger solutions should never be poured in through the proctoscope. The medicament must be applied directly to the diseased areas, and a little gentle rubbing is sometimes of value. When the general inflammation and irritation have subsided and the areas are more isolated, it is often advisable to apply lunar caustic directly to the lesions. When the entire colon is diseased, all such treatment is often of little avail, and even in less extensive lesions there is sometimes a poor response to treatment and the patient is seriously ill. In such cases the only recourse is ileostomy, and often it will have to remain permanent. After the ileostomy is done it is just as well to leave the colon untreated. The bowel seems to be able to take care of itself after the fecal current has been diverted and will often heal and contract down to a mere cord after a year or two. It is necessary to cut the ileum across and divert the fecal current completely, and appendicostomy or cecostomy with irrigations through the colon will fail more frequently than they will help. The operation should be done very carefully and the colon should not be handled at all. Colectomy is out of the question in the acute stages because the bowel will literally drip feces on the

slightest handling. In any event the removal of the colon is unnecessary because by healing and contracting the bowel nature will virtually inactivate it and produce the same ultimate result. Ileosigmoidostomy is ill advised because the beginning of the disease is always in the rectum, and it is there that the ulceration always heals last. If, therefore, the ileum is attached to the rectum or lower sigmoid, the constant discharge of the liquid ileal content into the irritable rectum will make the patient's existence unbearable. Ileostomy should therefore be considered a life-saving procedure, and a restoration to normal status later should not be promised. Patients have been literally cured by ileostomy, so far as regaining their normal weight and strength and returning to their regular activities are concerned. Others who have been thus benefited have had a recurrence after the severed ends of the ileum had been reunited.

Polyposis, polyps, and diverticulitis.—Adenomatous polyps are the types usually seen in the lower bowel, and they are usually pedunculated, though many are sessile. The small, sessile polyp, less than 1 cm. in diameter, is the only type which can be ignored, although it probably requires a little watching. They are very often seen high in the rectum or low in the sigmoid of patients who have diverticulitis. They are also seen below carcinomas with marked frequency. In fact, they may be called sentinel polyps, and whenever a lesion cannot be discovered above them very thorough roentgenologic studies of the sigmoid and descending colon should be made beyond the reach of the sigmoidoscope.

Multiple polyposis should be treated in much the same way as the severe grades of chronic ulcerative colitis; in fact, the two conditions are often found combined in the same patient. If the disease is extensive, ileostomy is necessary to save life. Local treatment in such cases is of little or no value.

Where there are several isolated polyps which are clearly benign, they should always be removed. All polyps of the colon should be regarded as potentially malignant and removed as soon as possible. This may be done by ligatures, cautery, snare, or the scalpel when low enough. Fulguration has advantages

over all of these because it is a much safer procedure except in cases in which the polyp is large and the pedicle can be seen to pulsate with large vessels. Then a special clamp, previously described,¹ can be used.

Diverticulitis can seldom be diagnosed definitely through the sigmoidoscope. Sometimes the openings into the diverticular pouches can be seen, they vary in size from about 1 to 10 mm.



Fig. 356—Diverticula in the sigmoid, descending colon, and splenic flexure

Most often it is evidenced by an immobility of the sigmoid, which gives the impression that there is something around the bowel partially fixing it and contracting the lumen. The little sentinel polyp is often present. The roentgenogram of the colon shows characteristic and diagnostic deformities (Fig. 356).

Cancer.—Over 75 per cent of cancers of the colon occur in the rectum and sigmoid, and over 80 per cent of the cancers affecting

these lowest segments occur in the rectum. Their appearance cannot be mistaken and the most inexperienced examiner should be able to make the diagnosis of malignant lesions. In the first place they almost always occur singly. I have seen only two patients in whom there were two separate malignant lesions in the sigmoid and rectum. In both instances the second lesion was in the sigmoid and had more the character of a diffuse degenerating polyposis. Once I examined a tumorous lesion on the posterior rectal wall that looked malignant. On the opposite wall, however, there were two small ulcers with a mild

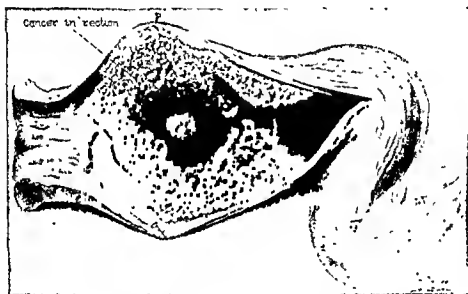


Fig. 357.—The mucosa contiguous to the carcinoma is uninvolved.

inflammatory reaction in the surrounding mucosa. The lesion felt malignant, but local treatment for six weeks was followed by complete healing. A specimen of the tumor was not taken, although it would be better to do so than to sacrifice the rectum. As a rule, however, specimen taking is bad practice, since it excites the growth of malignant lesions, so that a cancer may be rendered inoperable in two weeks.

A carcinoma seen through the proctoscope usually appears as a single proliferative, necrotic, and bleeding lesion (Fig. 357). It may occur as a growth or an excavating process on one or more

walls, or it may encircle the lumen of the bowel. The chief characteristic which differentiates it from all other lesions is the freedom of the immediately contiguous mucous membrane from any pathologic change. Normal mucous membrane adheres to the very margin of the cancer. This is of just as much diagnostic value as the microscopic findings

The subject of the treatment of carcinoma of the rectum and sigmoid can be dismissed with an expression of preference for the two-stage operation, which is by far the most satisfactory and should be carried out in almost all cases of operable lesions. Radium should not be used if lesions are large and operable. In some cases of small adenomatous growths of the lower rectum and around the anorectal margin, especially if the lesion is evidently of a low grade of malignancy, marvelous dissolution will sometimes result from radium properly administered.

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CERTAIN DIAGNOSTIC PROBLEMS IN OTOLOGY

HAROLD I. LILLIE AND CARL M. ANDERSON

The following cases are reported because certain practical differential diagnostic problems were encountered and solved. Cases I and II present a somewhat similar syndrome, as do Cases II and III. The remaining cases present individual problems having a practical bearing on treatment.

Case I. Chronic suppurative otitis media with mastoiditis, meningitis, and facial paralysis.—A man, aged thirty-nine, came to the Clinic November 27, 1922, because of vomiting, headache, and dizziness. About fifteen years before, he had had earache followed by discharge from the left ear, which persisted. Two weeks before admission, vertigo and persistent vomiting suddenly developed. The vertigo lasted for a week and on attempting to walk he noticed a tendency to fall to the right. During the last few days before admission, he had a severe headache in the parietal and frontal regions, and chills at night. On examination, elsewhere, two days before admission, a temperature of 102° was reported. The leukocytes numbered 24,300. There was rotatory nystagmus to the right; vertigo seemed to have disappeared two days before admission.

Examination at the Clinic revealed a very bad condition of the teeth, a moderate amount of mucopus in the nasopharynx, no abnormality in the nose or the right ear, the left ear membrana tympani thick and retracted, and a perforation at its lower margin with foul discharge. The patient appeared to be quite ill and complained of severe headache. There was a partial facial paralysis affecting the lower branches of the seventh nerve. The spinal fluid and all laboratory tests except the examination of the discharges were negative. The functional examination of the cochlea and vestibule of the left ear showed absence of response. A diagnosis was made of mastoiditis with labyrinthitis and possible intracranial extension.

A radical mastoidectomy and labyrinthectomy were performed December 6. On being opened the mastoid was found to be anatomically atypical. The dura of the middle fossa hung much lower than the dura of the middle ear. When, after considerable difficulty, the mastoid antrum was reached, a large mass of cholesteatoma was encountered. The middle ear and attic were filled with infected granulations. An extensive fistula into the horizontal canal and at the base of the vertical canal was found. The facial nerve was exposed below and in front of the horizontal canal. A labyrinthectomy, after the method of Neumann was performed. The dura over

the posterior portion was very red and infected with plastic lymph. On exploration of the region of the endolymphatic sac, a small amount of fluid was found. The bone was removed down to the internal auditory meatus and drainage was established through the promontory. The floor of the wound was closed with a vaseline pack over the dura, the external wound was left to granulate. Convalescence was somewhat protracted but satisfactory. The upper branches of the seventh nerve showed slight improvement. The patient was dismissed January 19, 1923, with instruction to return for observation. He returned May 30, and the ear was in good condition. No change was noted in the facial paralysis. June 11, 1924, he was again seen. The ear was in good condition.

With the clinical evidence of meningitis present, it was not easy to determine whether the syndrome was due to the meningeal disease or to a lesion in the end organ. Symptoms of meningeal irritation constitute a positive indication for surgical interference, according to some observers. However, one might be fearful of extending the infection by manipulation and disturbance of the natural barriers. The fact that the symptoms had not disappeared sooner suggested involvement of the end organ, for ordinarily the effect is so intense when the nerve is involved and the destruction so rapid, the symptoms of tinnitus and vertigo usually subside in the course of a few days. It was apparent that the patient was not making satisfactory improvement by the use of conservative measures, so surgical intervention was decided on. The findings were sufficient to show that the end organ lesion and the meningeal disease could coexist. The Neumann labyrinth operation was a happy choice, for it exposed the entire disease process. Probably any more conservative labyrinth operation would have fallen short of the purpose. We believe that when labyrinth symptoms are combined with meningeal disease the Neumann operation is the method of choice.

Case II. Chronic suppurative otitis media, facial paralysis, glossopharyngeal irritation, latent diffuse labyrinthitis.—A man, aged forty-six, came to the Clinic November 11, 1923, complaining of dull parietal pain, vertigo, discharging right ear, facial paralysis, and paroxysmal pain in the right upper cervical region, of six weeks' duration. Symptoms had followed immediately on an attack of typhoid fever. The parietal pain was constant, while that in the cervical region came on paroxysmally three or four times during the night and lasted for about fifteen minutes. About three weeks after the onset of the trouble, a polyp was removed from the right external auditory canal. Three days later paralysis of the right facial nerve occurred and was associated with loss of taste on the right side of the tongue.

Examination revealed no abnormality in the nose, tonsils, nasopharynx, pharynx, or larynx. The patient had a resolving facial paralysis on the right, muscular movements were slow. There was a misplaced molar on the right side of the mouth, and a periapical infection of the left upper second bicuspid. The left ear was normal in appearance and function. The canal of the right ear was tender and swollen; there was a slight discharge, and a large polyp at the isthmus. The pathologic report on a biopsy specimen from the polyp was "inflammatory tissue." Hearing and equilibration tests pro-

duced no response on the right. The caloric test on the left ear was normal except that there was no vertigo from the vertical canals. Roentgenograms of the mastoids revealed the right densely sclerosed with no air-filled cells present, and the left normal. After a complete general and neurologic examination, no positive diagnosis was made, but the possibilities of a tumor in the right cerebellopontine angle, meningitis, brain abscess, and chronic mastoiditis with involvement of the labyrinth were considered. There was also a possibility of glossopharyngeal neuralgia accounting for the peculiar paroxysmal pain in the upper cervical region. The patient was advised to have the infected tooth extracted. This was done November 20, with complete relief from the neuralgic pain. The pathologic condition in the right ear demanded radical mastoidectomy, and, as no positive diagnosis of an intracranial lesion could be made, it was decided to perform mastoidectomy, and then, if any involvement of the labyrinth was found, to perform a labyrinthectomy. At operation November 23, the removal of a very dense cortex uncovered a large excavated mastoid cavity. The middle ear was filled with granulation tissue which was difficult to remove. The disease process had uncovered the lateral sinus and dura mater over the middle cranial fossa and the facial nerve in the middle ear, and had produced a fistula into the horizontal canal. The labyrinth was opened after the method of Hinsberg. The patient convalesced uneventfully. The facial paralysis disappeared entirely in a few weeks. The patient gained weight and was dismissed from the Clinic February 15, 1924.

This case is of interest because of the difficulties presented in diagnosis; one anatomic lesion could not account for the various findings. The relief of the glossopharyngeal type of neuralgia by the removal of the infected tooth cleared the way for a diagnosis. Often in cases of diseased middle ear, the facial nerve becomes affected, although in this particular case, because both auditory and vestibular branches of the eighth nerve did not function, because the seventh was involved, and because of the affection of the vertical canal on the opposite side, the diagnosis of a lesion at the cerebellopontine angle on the right side was reasonable. However, there were no other neurologic findings to confirm this suspicion. There was also a possibility of acoustic neuroma as an independent lesion. In any event, it would have been necessary to clear up the mastoid disease before the lesion of the acoustic could have been approached. The condition disclosed at operation accounted for the syndrome except for the fault with the vertical canal on the opposite side. During convalescence the vertical canal functioned normally.

In Case II, in which it was difficult to establish a single anatomic lesion until the removal of the tooth, no involvement of the dura was found at operation, so that the more radical operation was not performed. Furthermore, since the patient was not seriously ill, less heroic measures sufficed. In both Cases I and II the lesions in the middle ear and mastoid were sufficient to provoke the labyrinthine symptoms and facial paralysis before operation. In Case II the paralysis cleared up completely in a very short time.

Case III. Bilateral otitis media with lateral and sigmoid sinus infection.—A boy, aged seven, was brought to the Clinic June 6, 1920, because of discharge from both ears. He was sent to the hospital as an emergency case. He had had a sudden onset of severe pain in the right ear with high fever following a cold. Two days afterward, paracentesis had been performed with only partial relief from pain. The left membrane ruptured spontaneously with temporary relief. One week, and two weeks, after the onset, he developed chills and high fever. About this time an abscess formed on the right leg. The temperature rose to 104°.

Examination showed that the tonsils had been removed; the nose, pharynx, and larynx were negative. Both external auditory canals contained a moderate amount of mucus with no odor. The drums were somewhat reddened, there was a small perforation in each, and there was slight pulsation. There was no bulging of the ear drums, no edema, swelling or tenderness of the mastoid on either side. Temperature was 101° and pulse 118. The patient was pale and appeared septic. The blood culture showed *Streptococcus hemolyticus*. The history, and the various findings justified a diagnosis of sinus phlebitis or thrombosis. The left mastoid was opened June 19, 1920. The mastoid disease was of the hemorrhagic type, but the sinus when exposed appeared normal. It was apparent that the blood was circulating. On exploration of the upper end, a paranasal abscess with definite phlebitis was discovered. The sinus was explored and free bleeding was encountered.

Following operation the patient seemed much better. There was a definite rise of pulse and temperature on the third day, which is not unusual with this type of infection. On the fourth day after operation the sinus was found to be collapsed at the lower end. It was deemed advisable to ligate the jugular vein. This was done June 23. This jugular vein was found to be thrombosed down to the level of the facial vein. A transfusion was performed the same afternoon without incident. On the second day the patient developed a low grade pleurisy with effusion. The convalescence from then on was rather slow but satisfactory. The patient was dismissed from the hospital on the thirty-first day following mastoid operation. He was under observation in the out-patient service for one month, after which he was dismissed from the Clinic in satisfactory condition. On his return to the Clinic two months later his health was good.

Case IV. *Staphylococcus septicemia* secondary to mastoiditis and sigmoid sinus thrombosis.—A boy, aged five, was admitted to the Clinic March 23, 1924. Early in February he had had measles. A week later he began to have pain in both ears, and at the end of four days both drums ruptured spontaneously. The right ear stopped discharging in two days and began to pain again, rupturing after a few hours. During this time the temperature was elevated somewhat, but the parents did not know how much. Mastoid pain was quite severe. Both ears continued to discharge and the temperature remained high. After three weeks a bilateral mastoid operation was performed; following this chills and a septic type of temperature developed. At one time the temperature was 107.4° by rectum, it remained above 102° . The child became greatly emaciated, and very intractable.

When examined the patient was emaciated, pale, and exhausted. His temperature was 101° and pulse 110. Both ears were discharging profuse yellowish stringy pus. Both mastoid wounds were open and discharging; neither sinus could be seen or felt. The nose was normal. There was evidence of a peritonsillar infection on the left side, and of bilateral cervical adenitis, more pronounced on the left side. Pressure over each jugular vein produced no change in the ophthalmoscopic picture. Blood culture disclosed many Gram-positive staphylococci. A transfusion of 400 c.c. of citrated blood and 100 mg. of gentian violet was given. The temperature then rose to 104.8° by rectum for twenty-four hours. Both mastoids and both jugular veins were explored. The right side was normal. The left side was thrombosed, and free pus was found in the jugular bulb. The plug was ablated and the jugular vein sectioned above the facial vein. Another culture, made from the blood taken at operation, proved to contain many Gram-positive staphylococci. One hundred milligrams of gentian violet was given intravenously at the time of the operation. The temperature was much lower, but it was still septic in type. On the eighth, tenth, twelfth, and fourteenth days after the operation the child had a chill with the temperature. From then on the convalescence was satisfactory. He began to gain weight and look bright. He was dismissed from observation seven days after admission, having gained 20 pounds. Both ears and there was but a slight discharge at the lower angle of the mastoid

not absolute proof, suggested that the ear was effected on the same side. When any uncertainty exists as to the side effected, both sides must be explored.

The findings at operation in Case III were quite discouraging, since the sigmoid sinus appeared to be quite normal from the knee to the bulb. The area was explored further because it was realized that infection could travel through the very small vessels. The exploration of the lateral sinus just above the knee exposed the area of phlebitis which was the focus of infection. The jugular vein was not ligated at once. If it had been effected well above the bulb, particularly if it had been thrombosed, there would have been no delay in ligating. Case IV illustrates that there is no set rule for the necessity of ligation.

In these cases blood transfusion is used as a routine. It not only exercises a supportive action, but it inhibits the destructive effect of the toxins and renews the broken-down elements of the blood.

The finding of the staphylococcus in the blood stream is rather unusual. The general opinion is that such a complication adds greatly to the danger. Other cases of sinus thrombosis have been treated in the same manner except that the gentian violet was not used in conjunction with the transfusion, although the transfusion was used as a supportive measure. It would be difficult to determine the effect gentian violet really had, although in a staphylococcus infection it is believed to be most effective. Because of the extreme intractability of the little patient and the fact that he was very ill, it did not seem best to have daily blood cultures made in order to learn at what period in the convalescence the blood became negative. In Case III gentian violet was not used in conjunction with the transfusion because its value was not known at that time. Its effect on staphylococcus infection cannot be determined from one administration, but it has been so favorably reported on by other surgeons that it deserves a place among the methods of treating septicemia, but not to the exclusion of others, whose value has been repeatedly demonstrated.

Besides the difference in the infecting organism, Cases III

and IV presented a very important difference in relation to the phlebitis; in Case III it had not produced a thrombosis. This failure indicates little or no ability to limit the infection, and is particularly serious when the infecting organism is the *Streptococcus hemolyticus*.

Metastasis to distant parts of the body need not necessarily be an unfavorable sign. After the removal of the primary focus the wide-spread zones of infection are usually readily disposed of: they require only symptomatic treatment. The extremely unfavorable general appearance would ordinarily deter a careful surgeon. Experience has shown, however, that these patients are never too ill to bear operation and that a fatal issue is frequently prevented by prompt operation on patients who are desperately ill. The prognosis is more favorable than it would appear.

Case V. Latent suppurative otitis media with mastoiditis and paranasal abscess.—A woman, aged forty-six, came to the Clinic January 7, 1925, complaining of deafness and throbbing in the left ear. Three weeks previous to examination she had had a slight cold which was thought to be an attack of influenza. For ten days she had had a severe earache on the left side. The pain subsided, but the marked deafness persisted with the throbbing sensation, which was increased by lying down. The first examination revealed redness and relative narrowing of the left canal. The left membrana tympani appeared thickened; both moved with the otoscope. There was no apparent tenderness on pressure over the mastoid. The roentgenograms of the mastoids revealed no abnormality in the right, but cloudiness of the left, particularly over the knee of the sigmoid sinus. The cells did not appear to be broken down. After thorough cocaineization of the left canal, both its wall and the membrana were found boggy. On inflation of the middle ear the sounds came through clearly.

The history of severe pain and sensation of throbbing, and the appearance of a boggy, thick membrana tympani combined with the roentgenograms justified a diagnosis of latent suppurative otitis media with mastoiditis and probable paranasal abscess. A complete mastoidectomy was performed January 12. A large amount of infected granulation tissue was found in the cells at the knee of the sinus. When these cells were removed, pus welled up from below. The sinus was found to be exposed over a large area, but there was no thrombosis. The mastoid was thoroughly exenterated. A wide paracentesis was performed and a dressing applied. The convalescence was rapid and satisfactory.

The absence of aural discharge and mastoid pain might have caused uncertainty in the diagnosis and discounted the possibility of the mastoid requiring surgical treatment. It is usually true that night pain of a throbbing nature, occurring in mastoid disease, is indicative of exposure of the dura either by paranasal abscess or epidural abscess. Indeed, it was this point in the history that aroused suspicion of the mastoid because the redness of the canal and the suggestion of narrowing beyond the isthmus were hardly sufficient evidence. The suspicion was confirmed by the excellent skiagram. More information is to be had by comparing the skiagrams of both mastoids. Without the history of otitis in childhood, in which case the mastoid may not develop so well, both mastoids are likely to be similar in type and conformation. When the diagnosis had been made, the management suggested itself clearly. Evidence insufficient for diagnosis may occasionally warrant exploratory operation.

Case VI. Narcotization or malingering simulating intracranial symptoms in a surgical mastoid condition.—A single woman, aged thirty, came to the Clinic November 11, 1924, in a semistuporous condition and was admitted as an emergency to the hospital. She had suffered from acute mastoiditis on the right side a year previously, which had been surgically treated at that time, and again six weeks later. She developed acute mastoiditis on the left side six weeks before admission. The mastoid had been opened and drained with relief from pain, but a small fistula persisted. Two weeks after this operation she complained of continuous pain over the left side of the head, associated with slight vertigo. The left antrum had been drained.

Examination showed a postoperative scar over the right mastoid with the ear in good condition. The left ear had a draining fistula and a boggy membrana with a great deal of tenderness. The pain was severe over the left side of the head, extending from occiput to the left frontal area. There was slight spontaneous rotatory nystagmus and slight vertical nystagmus on turning the eyes upward. The pupils, fundi, and reflexes were negative. Fields were negative to rough test. There was some mucous discharge from the nose. The blood Wassermann reaction after admission was negative, although it had previously been found positive. The neurologic examination established a tentative diagnosis of cerebellar abscess, because of the pain, lethargy, and so forth.

The mastoid was explored November 22. A large mastoid was found "filled and above the knee of the sinus. All condura over Trautman's" vaselin pack was inserted into the wound. The patient continued to be very restless and troubled with

insomnia and complained of indefinite pain. About this time, through relatives, it was discovered that she had been given fairly large doses of morphin for several weeks. All narcotics were discontinued and after a few days the nystagmus, restlessness, and peculiar dull appearance disappeared. She entered on an uneventful, but lengthy, convalescence. She was dismissed from the Clinic January 27, 1925. She could hear a low whisper with both ears; C4 fork was normal and C1 fork was —5 on the left.

The effect of the morphin had masked the real symptoms. Her nurse's training allowed her to simulate rather closely certain symptoms with which she was familiar. The real significance of the symptoms she manifested was discovered by accident. The door into her room was ajar through which she was heard to talk to her nurse in quite a rational manner. On the entrance of the physician, she immediately assumed her lethargic attitude. She was told that her deceit was recognized and would no longer be tolerated. The change in her attitude followed immediately. It is not probable that the amount of sedative she was receiving while under observation was sufficient to cause symptoms. It is felt that she was a malingerer. Her convalescence proceeded without incident.

Case VII. Total destruction of the inner table of the pars squamosa of the mastoid by long-standing symptomless cholesteatoma.—A man, aged



Fig 358—Normal side

fifty-five, came to the Clinic September 26, 1924, complaining of discomfort in the right ear. In 1896, this ear had discharged for six months following

pain, and it had annoyed him more or less since. In 1902, the ear discharged for a period of a year, a polyp was removed and after treatment the discharge ceased and did not recur. The tonsils were removed at this time. Before admission he again felt discomfort.

Examination revealed a small amount of granulation tissue and discharge on the posterior wall of the canal. There was no odor. A hook could be passed through the posterior wall into the large cavity. Cholesterol crystals were demonstrated in the discharge. After probing, the odor was charac-



Fig. 359 —Same case as shown in Fig. 358, showing destructive effect in pars squamosa in long-standing symptomless cholesteatoma.

teristic of cholesteatoma. The skigram showed a destructive lesion involving the bone corresponding to the outline of pars squamosa (Figs. 358, 359). A mastoid operation was advised, the nature of the operation to be determined after opening the mastoid.

On opening the cortex a definite defect was found in the posterior superior wall of the canal through which cholesteatoma was expressed. After complete removal of the cortex, a large quantity of pus welled up. The cavity was filled with cholesteatoma. The dura was uncovered by the disease process which extended to the zygoma in front. Posteriorly the process extended to the suture line. Over the labyrinth the dura was thin and adherent. While probing this region considerable cerebrospinal fluid escaped. The brain was pulsating, but did not protrude. The palpation findings were sug-

gestive of the possibility of a brain abscess. Since there had been no symptoms it was not explored. A very complete type of operation was necessary to remove the focus of disease. The middle ear was not disturbed as there was no evidence of pathologic change. The cavity was packed with iodoform gauze. The prognosis was very guarded on account of the break in the dura and the extensive disease process.

The convalescence was attended with a slight elevation of temperature. There was great difficulty in causing granulation tissue to form from the dura. By gently scarifying and packing with dry gauze, granulations were induced. The wound healed satisfactorily, but slowly. The patient returned for observation at intervals. When last seen March 3, 1925, the condition was very good. He had gained 15 pounds in weight and was greatly improved.

Inspection of the auditory canal revealed the nature of the disease process and operation was advised. The skiagram was taken as a routine measure and was of great assistance in showing the extent of the disease. No such condition had been encountered previously.

That cholesteatoma may produce its deleterious effect in a symptomless manner has been known and the experience was not new, but in this case the damage was more extensive. It might be maintained that without a demonstrated marginal perforation it would be impossible to have a formation of cholesteatoma. That is not borne out by our observations. There may have been a marginal perforation at the time of the antecedent otitis, but there was none at the time of examination. At the time of operation it was noticed that the dura was unusually smooth after the cholesteatoma had been peeled off. This did not occasion particular comment at the time, but subsequently, when it was found that granulation tissue did not form, it was thought that the dura was probably covered by epidermis. This is a reasonable conjecture under the circumstances. By carefully scarifying the dura with a serrated curette granulation tissue was encouraged to form, and the wound filled, although slowly.

Considerable atrophy of the dura had taken place over the petrous portion. In carefully cleaning up the débris the dura was opened and a certain amount of cerebrospinal fluid escaped into the wound. This fluid continued to drain for about seventy-two hours. No ill effect came from it, fortunately. Nothing was done to combat the flow other than loose pressure from gauze packing, as it was not felt wise or rational to oppose the

intracranial pressure. Observation has led us to believe that the effect of tamponing the meninges against the bone defect in such cases, by the intracranial pressure, limits the extent of the involvement in the dura, as it prevents pocketing. The leaking dura could not be packed without disturbing this protective bulging.

This case demonstrates the great natural resistance of the dura to circumscribed involvement of the disease processes.

THE TREATMENT OF CERTAIN TYPES OF POSTOPERATIVE COMPLICATIONS

WALTMAN WALTERS

Postoperative gastric retention by jejunostomy.—The patient whom I am presenting illustrates the value of the estimations of blood chemistry and early jejunostomy when postoperative gastric retention persists beyond six or seven days.

The work of Hayden and Orr, Eusterman, Dixon, McVicar, and Balfour has revealed characteristic changes in the chemical content of the blood of this group of patients; and their methods of restoring chlorids to the blood stream have carried many patients with postoperative gastric retention over that rough road of impaired renal function until normal motility returned to the upper gastro-intestinal tract.

The results obtained by Balfour and McVicar in more than twenty such cases, by using intravenous injections of chlorids and glucose solution, merit the attention of the surgeon, for they depended on blood chemistry values to reflect the patient's progress, when postoperative gastric retention appears, and to give the signal for surgical intervention when the obstruction was mechanical, and intravenous medication without avail.

The patient presented here had a Billroth I resection of the stomach for a large gastric ulcer situated on the lesser curvature about 2.5 cm. above the pylorus. Gastric retention developed the third postoperative day, and persisted. On the sixth day studies of the blood showed elevation in blood urea to approximately 122 mg. for each 100 c.c. and a reduction of blood chlorids to approximately 0.546 mg. for each 100 c.c. of blood. The patient's urinary output was decreased and his general condition far from satisfactory. At that time, unfortunately, we were not aware of the benefits obtained by intravenous injections of salt and glucose in such cases; consequently, it was decided to

perform a jejunostomy. Hugh McKenna's method of a two-catheter jejunostomy was used. Two No. 18 catheters were inserted into the jejunum, one being directed upward into the duodenum past the ligament of Treitz, and the other into the jejunum about 4 cm. distal to the first catheter, with the end directed downward. The lower catheter was for feeding and the upper for drainage of the stomach and duodenum. When the

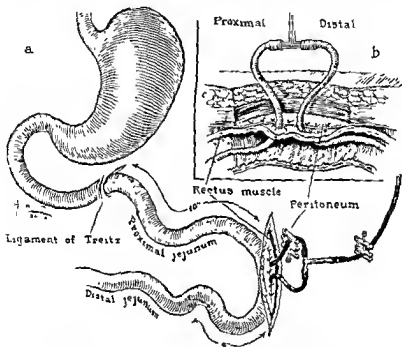


Fig. 360.—(a) Rubber tubes connected by T tubes for feeding and draining intestinal tract (b) Proximal tube fastened into bowel by purse-string suture, and distal tube held in place by Witzel suture.

lower catheter was not used for feeding, it was connected by a glass tube to the upper catheter so that gastric and duodenal contents passed from the upper to the lower catheter and then again into the jejunum, thus making use of a principle described by Wilkie (Fig. 360).

That the upper catheter effectively drained the stomach in both cases is illustrated by the fact that no fluid could be ob-

tained with the stomach-tube thereafter. With the improvement in the patient's general condition and a disappearance of gastric retention, further studies in blood chemistry were not made. Wilkie found that improvement occurred most rapidly when the duodenal secretion was allowed to flow back into the intestine and this led to the adoption of his method. The patient recovered; jejunostomy tubes were removed about two weeks later, and the wound closed spontaneously.

The reason for presenting this case is to call the attention of the surgeon first to the practical surgical application of studies of blood chemistry, and, second, to the value of the McKenna method of jejunostomy using two catheters instead of one, the proximal directed upward to drain the stomach and duodenum, the lower directed downward for feeding, and the two to be connected to prevent the loss of the gastric and duodenal secretions.

Duodenal fistula by jejunostomy.—The second patient is a man of about forty, who was operated on elsewhere nine months ago for acute cholecystitis, with removal of the gallbladder. After this operation a persistent sinus remained in one portion of the wound. The sinus was explored at the Clinic and an encapsulated mass which was in contact with the duodenum was removed. Eight days later a duodenal fistula occurred and duodenal secretion was discharged through a fistulous tract, approximately 8 mm. in diameter, in the center of the incision. A large rubber tube was inserted into the fistulous tract and connected with an electric suction apparatus. This kept the duodenal secretion from irritating the skin, and it was hoped that with the tract kept dry by this apparatus, healing would occur. During the next five days all fluids and nourishment taken by mouth were discharged from the duodenal fistula. As the patient's general condition was becoming rather alarming, it was decided to perform a jejunostomy, the catheter to be inserted with its end extending down the jejunum for feeding purposes.

Nourishment by mouth was discontinued, the patient being fed through the jejunostomy tube. Immediately the total quantity of fluid obtained from the duodenal fistula decreased, and the tract healed spontaneously during the next two weeks.

The patient's general condition improved and normal feeding by mouth was resumed. The jejunostomy tube was removed and healing allowed to occur spontaneously in the jejunostomy wound.

Cameron's paper on jejunal fistula summarizes the cases reported in the literature up to November, 1923, and reviews the various methods of treatment employed, with their results. He calls attention to the favorable influence on healing of the suction method of keeping the fistulous tract dry. In the case presented here it was necessary to perform a feeding jejunostomy because the patient was unable to get nourishment beyond the fistula, and it was feared he would die before the fistula healed.

The mortality in cases of reported duodenal fistulas is startlingly high, being approximately 50 per cent. No doubt in most cases the duodenal fistula is but an incident, and death is due to other causes.

This high mortality led Kilgore, Bollman, and me to study the cause of death in experimental duodenal fistula. We produced duodenal fistula in dogs, and found an increase in the alkalinity of the blood, a rise in blood urea, and a fall in blood chlorids. These changes are similar to those found by Dixon, McVicar, and Balfour in postoperative duodenal stasis, and by Haden and Orr in pyloric obstruction and obstruction of the upper gastro-intestinal tract.

EXPERIMENTAL OBSERVATIONS ON GLUCOSE AS A THERAPEUTIC AGENT

JESSE L. ROLLMAN

The oxidation of glucose within the normal organism provides the body with 60 to 90 per cent of the energy essential to existence. Recent work has shown that muscular activity is almost, if not completely, dependent on glucose or glycogen for the necessary chemical changes. Glandular activity likewise requires energy which is furnished in large part by the oxidation of glucose. The body temperature is, for the most part, maintained by the glucose of the body. The numerous chemical changes in conserving material for food and body repair and in preparing waste material for elimination are aided by energy derived from glucose. Toxic substances may be rendered harmless by oxidation by glucose, or glucose may actually combine with toxic substances so that nontoxic compounds, glucuronates, are formed and excreted. Since glucose is essential for so many and so important normal body functions, it is not surprising that it is such an efficient therapeutic agent in pathologic conditions.

In experimental studies, marked beneficial effects were observed from the administration of glucose to animals under various experimental and pathologic conditions. Many studies were possible only because the animals, mostly dogs, were kept in good condition with glucose. The results with glucose have been so convincing that conclusions of practical clinical value seem obvious. A brief review of the conditions in which glucose has proved of great value will illustrate this point.

HEPATIC DAMAGE

In all the conditions involving impairment of the liver the administration of glucose is of great value. Mann and Magath,

in their studies on the effect of complete removal of the liver, have clearly demonstrated that hepatectomized animals die because of a definite glucose deficiency and that their lives may be greatly prolonged by the administration of glucose. Following complete removal of the liver, there is always a marked and progressive decrease in the blood sugar. Coincident with this decrease a characteristic group of symptoms develop and progress until death ensues. These symptoms may be alleviated in a very striking manner at any time in their course by the administration of glucose. Animals in a comatose condition recover completely and appear entirely normal within three to five minutes. This effect is specific for glucose since different sugars and other substances are without effect unless they are immediately converted into glucose by the blood, as occurs with *injections of maltose or glycogen*. By repeated injections of glucose these animals may be maintained in good condition from twenty to thirty hours, whereas without glucose they rarely survive more than five hours.

The advantages of a carbohydrate diet for dogs with Eck's fistula were shown very clearly by Pawlow and his pupils. They found that dogs, after anastomosis of the portal vein to the vena cava with ligation of the portal vein so that the liver was deprived of all the portal blood, did not develop symptoms of "meat poisoning" if fed a diet of bread, milk, meat, and bones. However, these animals lose weight, become anemic, and have a few other symptoms suggesting a mild degree of chronic intoxication. We have found that the addition of large amounts of glucose to the diet allows the animals to gain weight and remain in good condition for a long time. If part of the liver is removed from an animal with Eck's fistula, the need for the administration of glucose is even more marked. If approximately 50 per cent of the liver is removed from these animals, it is necessary to inject glucose intravenously at frequent intervals for several days following operation until the animal is able to take food by mouth. It then remains in good condition as long as the diet consists mainly of glucose, but intravenous injections of glucose may become necessary if sufficient glucose

is not taken by mouth. Ligation of the hepatic artery in animals with Eck's fistula allows them to survive only a few hours, but with intravenous injections of glucose the course may be prolonged several hours longer.

Hepatic poisons, such as chloroform and phosphorus, are more effective in animals with diminished glycogen in the liver and less effective in animals with livers well filled with glycogen. Opie and Alford found that the injury to the hepatic tissue was least for each unit of poison if the animal was on a diet rich in carbohydrate, and greatest on a protein diet. Because of the difficulty of actually standardizing the damage done by these two poisons, no definite conclusions as to the value of treatment may be made. Mann and Williamson report a few cases in which definite symptoms improved rapidly following intravenous injection of glucose.

Jaundiced animals following obstruction of the biliary ducts appear to be benefited by the addition of a large amount of glucose to the diet. These animals remain in good condition and lose little weight for several months after operation. In a few instances well-marked, though temporary, improvement of the terminal condition has followed the intravenous injection of glucose.

RENAL IMPAIRMENT

Many conditions involving the kidneys are also aided by the administration of glucose. Bilaterally nephrectomized animals that receive intravenous injections of glucose remain in better condition than similar animals untreated. We have observed a number of cases of marked temporary improvement from symptoms of uremia immediately following an intravenous injection of glucose. These animals have regained consciousness from coma and muscular twitchings, convulsions have ceased, and they may stand and walk. This same reaction often occurs following the injection of glucose in animals showing definite symptoms of uremia during the course of severe nephritis or nephrosis. Ibuka has observed that transplanted kidneys which have recently ceased to function may be stimulated to activity again by intravenous injection of glucose. Glucose acts as a

diuretic in these kidneys as well as in normal kidneys, and causes an increased excretion of urine.

GENERAL CONDITIONS

Conditions other than those of definite hepatic or renal damage may be benefited by the free administration of glucose. This method is valuable in the preoperative preparation of many animals that would be poor surgical risks if no special precautions were taken. Many animals with gastro-intestinal disturbances and similar conditions which cause them to lose weight and do poorly on diets which are ordinarily quite adequate, gain weight and appear in better condition with the administration of glucose. Many postoperative conditions also respond well to glucose. We have recently observed several cases of pneumonia in which there was rapid improvement and recovery following the intravenous injection of large amounts of glucose solution. The improvement in these cases is not so striking as in cases of affections of the liver, but the results point very clearly to the great value of glucose.

METHODS OF ADMINISTERING GLUCOSE

The methods of administering glucose depend on the condition of the animal. If it will take sufficient food a mixture of milk and commercial corn syrup is allowed. This may be given by stomach-tube in cases in which it will be retained and absorbed. The rectal administration of glucose is of little practical value because the amount which may be given in this manner is too small. If dilute solutions are given, the amount of fluid is too great to be retained, and if concentrated solutions are given absorption is so delayed that fermentation and local irritation often result. Intravenous injection of glucose is the method of choice if it cannot be given by mouth. We have found this method very efficacious and free from any deleterious effects if the proper precautions were taken to use nothing but pure sterile glucose solutions.

Any toxic effects of the intravenous injection of glucose may be entirely due to faulty technic in the preparation of the solu-

tion which in itself is entirely free from any toxic effects. A few years ago it was found that a number of commercial brands of "pure" glucose produced death in dogs a few minutes after the intravenous injections of such small amounts as 200 mg. of glucose for each kilogram of body weight. Because of this the glucose is always tested biologically before it is injected into a valuable animal. This is accomplished by intravenous injection of a solution containing 5 gm. of the glucose to be tested for each kilogram of body weight of the test dog. If no reaction is observed in this animal, the glucose is safe.

The symptoms following intravenous injections of impure glucose solutions depend on the toxicity of the solution and the amount injected. The usual course begins with vomiting a few minutes after injection. The vomitus is at first clear; later it may become bloody. Accompanying this is a slow pulse and a subnormal temperature. The respiration tends to be slow and is frequently irregular. Muscular twitchings are present and increase in extent and severity until generalized convulsions occur. If the animal survives more than a few hours there is a severe diarrhea, and as the severity increases the discharge becomes tinged with blood and later is markedly hemorrhagic. The animal gradually becomes comatose and death ensues. The extent of this course of symptoms may vary from emesis to death within a few minutes with but few symptoms, depending on the amount and toxicity of the solution injected. At necropsy all organs are found to be markedly congested and frequently show numerous petechial hemorrhages. The meninges of the brain and spinal cord also show this change. The gastric mucosa appears intensely hemorrhagic and there are hemorrhagic areas scattered throughout the entire intestinal tract, most extensive in the lower portions of the intestine and more marked in the colon.

Other causes of reactions with glucose are due to failure to observe certain precautions in the preparation of the solution for intravenous injection. Only pure distilled water should be used. Samples of distilled water are sometimes found to be toxic, but this objection may be easily overcome by the use of

triple distilled water which is sterilized in flasks immediately following the last distillation. Sterilization of the solution is best accomplished by boiling over gentle heat for a period of fifteen minutes. Discoloration of the solution results from rapid heating or from superheating, so that sterilization by steam under pressure should be avoided. In the same way alkalis cause a rapid disintegration of glucose when heated; therefore, alkalis should never be added to glucose solutions before sterilization. Since glucose solutions are such excellent mediums for the growth of bacteria and moulds, the solution should be used immediately, and any excess should not be trusted for subsequent injections. The following technic should be adhered to. Add the desired amount of biologically tested glucose to a gauze-stoppered flask containing the proper amount of pure sterile distilled water, bring to boiling with slow heat, such as a low flame or an electric heater, and boil for fifteen minutes. When the solution has cooled to body temperature it is ready for intravenous injection by any good aseptic technic.

The concentration of the glucose solution may be varied between 10 and 50 per cent with safety, the main point of variation being the administration of either large or small amounts of fluid. In general a 20 per cent glucose solution is best; other concentrations are used only in particular cases. The amount of solution which may be given is also variable, but amounts up to 30 c.c. for each kilogram of body weight may be given with safety. Since a 20 per cent glucose solution contains only 800 calories for each liter of solution, large amounts must be given if any beneficial effect is to be expected from its food value. Large amounts of glucose may be given with no untoward effect. By repeated injections dogs have been kept in good condition for more than three weeks without other food. By injections of from 6 to 8 gm. of glucose each day for each kilogram of body weight these animals lose but little weight during that period.

DISCUSSION

Most of the energy necessary for the continuance of the varied functions of the body in health or disease is derived from

the oxidation of glucose. The minimal daily requirement of the body at rest is the equivalent of 6 to 8 gm. of glucose for each kilogram of body weight. Additional amounts of glucose are required for the performance of work or for the storage of reserve supplies of glycogen and fat. If this amount of material is not provided the body obtains it at the expense of the stores in the tissues. For this reason some of the beneficial effects of glucose may be due to its value as a food. Glucose alters the nature of metabolism, the respiratory quotient being increased toward unity, which indicates a greater utilization of carbohydrate in the body and a lessened destruction of protein and fat. This change in the metabolism of the cells of the body may have an important relationship to their reaction against disease. The saving of protein by this increased utilization of glucose allows less tissue destruction and more tissue repair, and there are less nitrogenous waste products formed so that the kidney is spared the effort necessary for their excretion.

The oxidation of fatty acids in the body depends on the simultaneous oxidation of glucose, and insufficient oxidation of glucose results in the accumulation of fatty acid residues and acetone bodies with resultant acidosis. This results not only in cases of diabetes when the oxidation is deficient, but in normal persons from fasting when insufficient amounts of glucose are present. The administration of glucose reduces acidosis by allowing complete oxidation of fatty acids, and for this reason the alkaline reserve of the body is increased. In the same manner other toxic material is probably rendered harmless in the body by oxidation to less toxic forms or by complete oxidation to carbon dioxide and water. While oxidations of this nature may not be directly connected with the oxidation of glucose, nevertheless the presence of large stores of glucose greatly inhibit the toxic action of substances like chloroform and phosphorus. Many toxic substances, such as phenols, cresols, salicylates, and camphor, are detoxified by direct combination with glucose to form glucuronates which are much less toxic and can be excreted in this form, causing little damage to the body tissues.

Glucose is also valuable as a diuretic and in this way may be of value in aiding the excretion of toxic materials from the body. Its diuretic action is due to its affinity for water which enables it to carry water through the kidney, and this action is exerted on all the tissues of the body. The fluid excreted is thus withdrawn from all the tissues and is later replaced when more water is available. Besides the stimulation of excretion of urine, other vital processes may be stimulated by this exchange of water and alteration of the concentration of the many chemical substances within the cell. As evidence of this stimulation is the apparent increase in the production or liberation of insulin following the administration of glucose, since the sugar content of the blood decreases below its former level soon after the excess glucose is disposed of, and since a second injection of glucose at this time disappears more rapidly from the blood than did the first. The alteration of the character of metabolism following glucose administration is further proof of the changed reactions of the body cells.

Glucose may be regarded as a specific therapeutic agent in cases of hypoglycemia, such as follow total removal of the liver, and in a few cases of extensive hepatic destruction, or in hyperinsulinization. Glucose is such an essential part of so many reactions of the body that many other conditions may be greatly improved by its use. The administration of large amounts is a valuable therapeutic aid in a variety of experimental and pathologic conditions. Such a valuable adjunct as glucose in experimental conditions appears to be capable of equally good usage in a number of clinical conditions. Four main points seem directly applicable. (1) it is of great value in the treatment of a variety of conditions, (2) large amounts may be required in severe cases before any marked improvement may be expected; (3) large amounts may be given intravenously without causing any deleterious effect, and (4) untoward effects of its administration arise from improper technic in the preparation of the solution for intravenous injection. A simple technic is given which obviates these errors in preparation.

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MUCOCELE OF THE FRONTAL SINUS SIMULATING ORBITAL NEOPLASM

JOHN F. GIPNER

In the differential diagnosis of cystic tumors of the upper inner angle of the orbit, mucocèles of the nasal accessory sinuses, sebaceous and dermoid cysts, anterior orbital meningo-encephaloceles, cysts of the entozoa echinococcus and cysticercus, blood cysts resulting from previous hemorrhage, and mucocèles of the lacrimal sac must be considered.

The three cases reported here presented the clinical picture of primary orbital cysts or neoplasms. Although the possibility of mucocèle was considered in each case, the absence of a history of nasal disease and the lack of signs of nasal inflammation made the lesions appear to be new growths of the orbit.

REPORT OF CASES

Case I.—A married woman, aged forty years, came to the Clinic October 1, 1918, complaining of displacement of the left eye. Eight years previously she had been troubled with epiphora from the left eye, followed shortly by a proptosis of the eyeball downward and outward, and swelling of the lids. She had had very little pain and there was no history of accompanying nasal inflammation. She had had no diplopia. Medicine had been given which was supposed to cause absorption of a tumor of the orbit. One ophthalmologist diagnosed her condition as being due to exophthalmic goiter. Spinal treatments had been given at a health resort, and in four months the goiter (?) had disappeared.

Examination revealed vision 6/5 in the right eye, 6/15 in the left, and proptosis of the left eye measuring 9 mm. The globe was pushed down and outward; the lids were not swollen. The conjunctiva and cornea were clear. A slightly movable cystic mass was palpable between the eyeball and the upper rim of the orbit. There was no tenderness on pressure at the orbital rim. Transillumination of the mass was clear, but there was a suggestion of cloudiness of the frontal sinus of that side. Roentgen-ray examination of the sinuses was reported as negative. There was no extra-ocular paralysis. The tonsils were slightly enlarged. The mucous membrane of the nose was somewhat congested, but no pus or points of contact were seen. The rhinol.

ogist could not say whether the cyst was a *mucocele* or an orbital neoplasm. The Wassermann reaction was negative (Fig 361)

At operation a large cyst filled with thick, tenacious, slate-colored mucus was encountered. The frontal sinus was markedly enlarged so that the upper inner one-quarter of what should have been a part of the orbital cavity was occupied by the frontal sinus and accessory cells. There were three large cells divided by thin bony septums. Each cavity was filled with mucus. The lower floor of the sinus was composed of bony projections over which a thin fibrous membrane was stretched, thus constituted the roof of the orbit. The eyeball could not be pushed back because of this bony formation. The right frontal sinus was directly connected to the left by an opening large enough to admit the little finger. The nasal wall was opened



Fig 361 —Proptosis of the left globe before operation.

at the floor of the lower cell and the nasofrontal duct enlarged so that gauze wicks could be pushed into the nose. The patient's convalescence was uneventful.

Case II.—A girl, aged fifteen years, came to the Clinic April 14, 1920, because of gradually increasing prominence of the right eye for a year. The left eye was normal in size but there had been a recent attack of measles. The right eye remained about the same size.

Examination revealed a markedly proptosed right eye which was displaced downward and outward. In the primary position the eyes were straight,

but there was limitation of rotation in the field of the right external rectus. There was tenderness on deep palpation at the upper inner angle of the orbit and the bony margin was uneven. A definite mass could be palpated. The lower rim of the orbit could be felt only with difficulty because of the displacement of the eye downward. The globe was negative. Roentgenograms disclosed a cystic area in the upper right corner of the orbit, and a diagnosis of mucocele was suggested. However, examination of the nose was entirely negative and there was no evidence of involvement of any of the nasal sinuses (Figs. 362, 363).

At operation the anterior part of the frontal sinus had an erosion 1 cm. in diameter just above the orbital margin at the juncture of the middle and



Fig. 362.—Appearance of right eye before operation.



Fig. 363.—Same case as Fig. 362 six months after operation.

outer thirds of the brow. The sinus was very large, extending from the median line of the head across to the temporal bone. Ten c.c. of thick, brown, odorless fluid was removed. The roof of the orbit was eroded and the globe was protected by the fascia and lining membrane of the sinus only. The wound was partly closed and a cigarette drain inserted. Good drainage through the nose was maintained. Two months later the eyes were in proper position, without ptosis, and the extra-ocular movements were normal.

Case III.—A man, aged forty years, was seen in the Clinic January 5, 1924, and a diagnosis of late central nervous system syphilis of the meningeal type was diagnosed and treatment was started.

The neurologic examination was negative except for slight sensory disturbance of the lower limbs and a moderate *ptosis* of the right upper lid, which was attributed to a meningeal syphilitic process. There was no history of pain or inflammation around the orbit, and the eye had never been injured. The vision at this time was 6/6, with correction in the right eye. The vision of the left eye was 6/60 with correction, and was amblyopic, due to high hyperopia. No proptosis of the right eye was noted, and it was believed that the ptosis was of meningeal origin. The nasal examination was negative.

February 2, 1925, the patient was again seen. He said that the right eye had gradually become prominent without pain or inflammation. The right upper lid was edematous. The eyeball was proptosed about 3 mm.



Fig. 364.—Two days after operation, showing drain and stitches *in situ*.

and depressed 5 mm. Movement of the eye was limited in all directions, but more especially in elevation. Transillumination of the frontal sinus and examination of the nose were negative. A tentative diagnosis of right orbital cyst was made, reserving the diagnosis of mucocele of the frontal sinus because of the history and negative nasal findings (Fig. 364).

At operation a large cyst was found which opened through the roof of the orbit into a very large frontal sinus. This opening was about 1 cm. in diameter. The frontal sinus and the cyst were filled with thick yellowish-brown, foul-smelling mucus. The right and left frontal sinuses communicated by a large osteum. The nasofrontal duct was enlarged for drainage and a cigarette drain inserted into the sinus through the wound. The sinus in the upper lid healed after one and one-half weeks. An intranasal operation

was performed later, further to enlarge the nasofrontal duct and to uncap the neighboring ethmoid cells

DISCUSSION

All the other patients with mucocele examined in the Clinic have given positive histories of severe headaches or acute nasal inflammations which finally subsided with little further trouble until the mass in the orbit was discovered. Usually such inflammations followed influenza or severe colds in the head. Most of the patients also had changes in the nose, such as polyps under the middle turbinate, cloudy antrums and frontal sinuses, and purulent sinusitis. The roentgenogram was frequently positive, but not constantly so. The development of a mucocele is chronic in contradistinction to the suddenness of orbital cellulitis and phlegmon.

In Case I there was no history of nasal inflammation. In Case II the eye became proptosed during an attack of influenza and measles, while in Case III there was no history of nasal trouble. None of these cases had the intranasal changes mentioned. The Roentgen-ray examination was negative in Case I, suggestive of mucocele in Case II, and in Case III a Roentgen-ray examination was not made. The long-standing ptosis, together with the coincidental meningeal central nervous system syphilis, helped to complicate the clinical picture in Case III.

CONCLUSIONS

In some cases of mucocele of the frontal sinus there is no history of preceding local inflammation, no intranasal lesion, and the Roentgen-ray findings are not typical. The only symptoms are ptosis and ocular muscle disturbances. They cannot, therefore, be distinguished from primary orbital neoplasms before operation.

SPLANCHNIC BLOCK

JOHN S. LUNDY

It is not intended that splanchnic anesthesia shall usurp the position of general anesthesia, it is regarded as an aid. It undoubtedly lessens the amount of anesthetic inhaled and sometimes entirely eliminates general anesthesia. From October 14, 1924 to January 1, 1925 it was employed in thirty-two cases in the Clinic. From January 1 to March 14, 1925 it was used in 152 cases. In this series of 184 cases it was used as follows:

With Complete Satisfaction

Duodenal ulcer .	35	Acute appendicitis	1
Gastric ulcer	5	Retroperitoneal tumor .	1
Carcinoma of the stomach	16	Gastrojejunal ulcer	3
Kidney disease .	6	Diverticulum of duodenum	1
Gallbladder disease	6	Tumor of the pancreas .	2
Strangulated femoral hernia	1	Stricture of common duct	1
Carcinoma of the liver .	1	Intestinal obstruction	1
Fecal fistula .	1	Jejunal ulcer	1
Carcinoma of the colon	2	Ureterolithiasis .	1
Carcinoma of the rectosigmoid	1		

With Fair Success

Duodenal ulcer .	6	Duodenitis . .	1
Gastric ulcer .	1	Tumor of the pancreas	1
Carcinoma of the stomach	1	Appendicitis .	1

Of 184 cases, eighteen were intended to be combined with general anesthesia; seven patients had no anesthesia of the abdominal wall, and therefore required a general anesthetic. In these twenty-five cases the independent efficacy of the splanchnic anesthesia cannot be determined. In two other cases the injection was made for the diagnosis of obscure abdominal pain. The purpose was accomplished, but these cases cannot be included

with the operative ones. For statistical purposes, therefore, these twenty-seven cases have been deducted. Of the rest the anesthesia was completely satisfactory in 55.4 per cent, fairly satisfactory but sufficient in 8.2 per cent, while combination with general anesthesia was obligatory in 36.3 per cent. In the last figure are included all cases in which such obstacles as pain, nervousness, and nausea necessitated the induction of general anesthesia. In the whole series nausea occurred either during the injection or during the operation in twenty-seven cases.

These cases were not selected because they were particularly suitable for local anesthesia. Indeed, forty-three were considered poor prospects, although in only thirty-three of them was the prophecy borne out.

The zone of field block or of paravertebral block used in conjunction with splanchnic block varies with the site of the field of operation. The usual procedure for operations in the neighborhood of the pylorus is to surround the area included between the outer borders of the recti, from xiphoid to umbilicus, with a zone of novocain impregnation. The patient lies in the ordinary supine position, and the skin is prepared surgically. Physiologic sodium chlorid solution, with 0.5 per cent novocain, and 1 minim of epinephrin to every 10 c. c. of solution, is injected subcutaneously and intramuscularly. The amount varies.

When the field block has been completed the patient turns over, and a pillow is placed under the abdomen and anterior superior iliac spines in such a way as to elevate the vertebral spines and render them easily distinguishable. If the abdomen is tender, the pillow is adjusted to bear the pelvis. The hips should be level and the body straight. The prone position is better than the lateral because it is desirable to insert the splanchnic needles, one on each side, before injecting. The splanchnic block is thus accomplished from the posterior approach. Wheals are raised near the under edge of the twelfth rib, 7 or 8 cm. from the median line. The spine of the first lumbar vertebra is located by sighting a line through the two wheals and also by palpating the fourth lumbar spine at the

level of the crests of the ilia and locating the lumbar spines in sequence. When inserting the needle, the point of the middle finger of the left hand rests on the tip of the spinous process of the first lumbar vertebra; the point of the left thumb rests on the skin near the wheal; the point of the left index-finger massages the soft tissue between these two digits, and assists in feeding the muscles and fascia up over the needle so as to avoid its jerky entrance. A short needle (50 mm.) is thus thrust through the wheals already raised, and from 2 to 4 c.c. of solution are injected along the course to be pursued by the longer needles (120 mm.), which are next placed so that their points rest against the lateral borders of the body of the first lumbar vertebra. If the bony contact is painful, 2 or 3 c.c. of solution are injected to facilitate the moving of the needle point to the region just anterior to the lateral surfaces of the body of the first lumbar vertebra. If blood appears, the needle is changed to avoid the vessel. Frequent aspirations will locate blood-vessels if the needle point enters them. The needle is advanced no further than 1 cm., and usually less, after its point last comes in contact with bone. When possible the splanchnic needle is passed above the transverse process of the first lumbar vertebra, but, if necessary on account of pain, may be inserted below it. The spinal nerves must be avoided; paresthesia should be slight and should serve as a warning. In very large patients the needle may be submerged almost entirely. In smaller patients usually two-thirds of the shaft of the needle disappears into the tissue before the prevertebral space is reached. After the needles are in position, the solution of 0.5 per cent novocain is injected slowly, 10 c.c. on each side alternately, until from 25 to 50 c.c. are placed on each side. The amount to be used and the rate of injection depend on the patient's ability to tolerate the solution. If signs of toxicity appear, the injection may be delayed or discontinued if necessary. Shock or severe reactions are to be avoided and are not frequent with this method of inducing splanchnic anesthesia, especially if a hypodermic of caffein-sodio-benzoate is given for the first slight reaction, or an ampule containing 7.5 grains of caffein-sodio-benzoate may be

given as a prophylactic measure against shock. It will neutralize at least some of the severe effects of large doses of novocain which have been given too rapidly. Not all patients need the caffein, but it should be used if shock seems to be imminent.

ILLUSTRATIVE CASES

Case I. Upper abdominal field block and splanchnic block; cholelithiasis; cholecystostomy and cholecystogastrostomy.—The patient, a woman aged fifty-two, weighed 120 pounds, and was 5 feet, 1 inch in height. The risk was estimated to be 3, on a basis of 1 to 4. After a preliminary hypodermic of $\frac{1}{4}$ grain of morphin and $1/150$ grain of atropin, an abdominal block and a double splanchnic block were accomplished. The usual routine was followed, except that the right side of the block was reinforced because the incision was to be made on that side. The patient's usual pulse was about 84. Just before the injection was started it was 92, and during the abdominal block it became 100. The patient complained of slight dizziness when 100 c.c. of the solution had been injected. As usual, when the patient is in the supine position, the vertigo was transient. For splanchnic anesthesia 45 c.c. were injected on each side. A total of 250 c.c. was used with 25 minims of epinephrin. The patient had been given an ampule containing 7.5 grains of caffeine-sodio-benzoate. The abdominal and splanchnic blocks were complete in thirty-one minutes, which is the average time necessary if resections are to be avoided. At this time the pulse was 108. The operation was begun sixty-seven minutes after the completion of the injection and was finished in forty-four minutes. Anesthesia lasted approximately two hours or more, during which time cholecystostomy and cholecystogastrostomy were performed painlessly and without nausea. The pulse was 80 during the operation and 78 when the patient returned to bed.

Case II. Upper abdominal field block and splanchnic block; obstructing duodenal ulcer; gastro-enterostomy.—The patient, a woman aged sixty-five, weighed 76 pounds and was 5 feet, 3 inches in height. She was prepared for exploratory laparotomy because of pyloric obstruction. She had had no preliminary medication. Local anesthesia was chosen because of her age and the desire of the surgeon to eliminate or to minimize so far as possible general anesthesia in her case. The systolic blood-pressure was reduced recently from 230 to 134, and the diastolic from 130 to 86. The pulse was 88, but increased to 100 at the beginning of the injection. The patient was a good prospect for local anesthesia. The abdominal wall was blocked with 110 c.c. of 0.5 per cent novocain solution, the same technic being used as for Case I. The posterior splanchnic block required 25 c.c. of the 0.5 per cent novocain solution on each side. The total solution used was 160 c.c. together with 15 minims of epinephrin. The pulse at the end of the injection was 128 with slight transient tremor. There was no other sign of a reaction. The entire injection was accomplished in twenty minutes. The operation was begun twenty-three minutes later, and was finished in thirty-

five minutes. The duration of anesthesia was an hour or more. During operation the pulse varied from 80 to 88. Exploration and posterior gastro-enterostomy were performed painlessly and without nausea. Throughout the operation vigorous peristalsis of the stomach was observed. The patient was allowed to be up and out of bed on the ninth day after operation, and was sent home on the fifteenth day; recovery was uneventful.

Case III. Upper abdominal block and splanchnic block; gastric carcinoma; partial gastrectomy.—The patient, a man aged sixty-six, weighed 148 pounds, and was 5 feet, 10 inches in height. He was prepared for partial gastrectomy. A grain of codein was given hypodermically thirty minutes before he came to the operating room. Local anesthesia was chosen because of his age and the desirability of minimizing or eliminating general anesthesia. He was graded as a risk 4, and was a poor prospect for local anesthesia. Posterior gastro-enterostomy had been performed three weeks before. Injection was carried out in the same manner as in Case I, 230 c.c. being used for the abdominal block and 40 c.c. on each side for the splanchnic block, a total of 310 c.c. of 0.5 per cent novocain solution. The pulse at the beginning of the injection was 80 and throughout the injection was 84. After 200 c.c. of solution had been used slight tremor was noticeable and no further epinephrin was given. The prospect for anesthesia was now considered fair. The injection was accomplished in thirty-nine minutes. Operation was begun twenty-two minutes later, and was finished in fifty-five minutes. The duration of anesthesia was at least an hour and a half. Partial gastrectomy was performed without pain and with but slight nausea and moderate perspiration. The patient left the table in fairly good condition, somewhat pale, pulse 88, respirations 24. He was allowed to be up out of bed the twelfth day after operation and was sent home the seventeenth day. He was kept in bed longer than usual because the abdominal wound had been difficult to close. Recovery was uneventful.

Case IV. Upper abdominal field block and splanchnic block; duodenal ulcer and chronic appendicitis; excision, gastroduodenostomy, and appendectomy.—The patient, a man aged forty-six, weighed 124 pounds and was 5 feet, 6 inches in height. He was prepared for exploratory laparotomy. The preoperative diagnosis was duodenal ulcer with obstruction. Local anesthesia was chosen to eliminate or minimize general anesthesia. He was very pale and thin and was considered a risk 2. Thirty minutes before coming to the operating room 1 grain of codein and 1/150 grain of atropin were administered. The patient was a very poor prospect for local anesthesia. Injection was made as in Case I, 190 c.c. of solution being used for the abdominal block and 40 c.c. on each side for the posterior splanchnic block. One extra injection of 20 c.c. was given in the neighborhood of the right tenth dorsal intervertebral foramen. The entire injection was accomplished in twenty-nine minutes. The pulse was 78 when the injection was started, dropped to 68 during the injection, and rose to 92 when the injection was finished. There was no apparent reaction. It was expected that the injection would have to be combined with general anesthesia. Operation was

begun twenty minutes after injection had been completed and was finished in thirty minutes. Anesthesia lasted about an hour, during which time a knife excision of the ulcer was performed. Gastroduodenostomy and appendectomy were performed without any pain or nausea and without any general anesthesia. During operation the pulse was 100 and at the close of operation the pulse was 110 and his condition good.

The most interesting feature of this case was the particularly good anesthesia for the appendectomy which is not ordinarily obtained with a splanchnic block at the level of the first lumbar vertebra.

Case V. Paravertebral block and splanchnic block; pyonephrosis and nephrolithiasis; excision of the kidney.—The patient, a woman aged sixty, weighed 120 pounds and was 5 feet, 4 inches in height. She had had no preliminary medication. She was prepared for nephrectomy. Local anesthesia was chosen in order to eliminate or minimize the amount of general anesthesia which might be necessary. This patient was graded as a risk 2, but she was a good prospect for local anesthesia. The injection accomplished a paravertebral block of the right first, second, and third lumbar nerves, using 7 c. c. of 1 per cent novocain solution for each nerve, and of the ninth, tenth, eleventh, and twelfth thoracic nerves, using 5 c. c. for each nerve. A posterior splanchnic block on the right side was accomplished with 30 c. c. of a 0.5 per cent novocain solution. The total solution used was 41 c. c. of 1 per cent novocain solution and 30 c. c. of 0.5 per cent solution with 7 minims of epinephrin. The pulse was 112 at the beginning of injection, 136 at the end of injection, 72 during operation, and 78 at the close of operation. The injection was accomplished in ten minutes. The only visible reaction was slight tremor. The operation was begun ten minutes after the completion of the injection and was finished in twenty-seven minutes without pain or nausea. The right kidney was removed. The patient was allowed up out of bed on the tenth day after operation, and was sent home on the fourteenth day. Recovery was uneventful.

Case VI. Paravertebral block and splanchnic block; ureterolithiasis; ureterolithotomy.—The patient, a man aged forty-eight, weighed 147 pounds and was 5 feet, 8.5 inches in height. He had had a preliminary hypodermic of $\frac{1}{4}$ grain of morphin and $1/150$ grain of atropin. He was prepared for a left ureteral lithotomy. The stone was in the upper third of the ureter. Local anesthesia was chosen because of the surgeon's desire to eliminate or minimize the usual amount of general anesthesia. The patient was graded as a risk 2. The injection was a paravertebral block of the left first, second, and third lumbar nerves, using 10 c. c. of a 1 per cent novocain solution for each nerve, and of the ninth, tenth, eleventh, and twelfth thoracic nerves. A posterior splanchnic block was completed at the level of the first lumbar vertebra with 50 c. c. of 0.5 per cent novocain solution. This injection was accomplished in fifteen minutes and the patient's pulse, which was 108 at the beginning, was 112 at the end of the injection. Due to unavoidable circumstances the patient was delayed in being taken to the surgeon for an hour. It was found that anesthesia was beginning to wear off, so that the

injection was repeated as before except that 30 c c were used for the splanchnic block. The pulse was 124 after the second injection, which was accomplished in twenty minutes. The operation was begun twenty minutes after the injection was completed and was finished in ten minutes without pain or nausea. At the beginning the pulse was 134 and during operation it dropped to 64. The patient was a good prospect for local anesthesia. The total amount of solution was 140 c c. of 1 per cent and 80 c.c. of 0.5 per cent novocain solution together with 30 minims of epinephrin. The patient was allowed out of bed on the tenth day after operation, and was sent home on the thirteenth day. Recovery was uneventful.

